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ABSTRACT

This user guide is comprised of the text of a series of lectures designed to establish an understanding of available data resources in several scientific and technological areas. Presentations of general information on this subject and more detailed examples of specific scientific, medical, and governmental systems are included. The following papers are presented: Present Knowledge Domain of Scientists and Technologists, Anthony Debons; Generation, Use and Transfer of Information, Allen Kent; International Medical Information Systems, George-E. Unger; Federal Information Systems, Fred S. Dyer; The NASA Regional Dissemination Center, Edmond Howie; International Information Systems for Physical Scientists, Charles K. Bauer; and Environmental Information Systems, Marta L. Dosa. (KP)

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NORTH ATLANTIC TREATY ORGANIZATION

ADVISORY GROUP FOR AEROSPACE RESEARCH AND DEVELOPMENT

(ORGANISATION DU TRAITE DE L'ATLANTIQUE NORD)

AGARD Lecture Series No.69

# HOW TO OBTAIN INFORMATION IN DIFFERENT FIELDS OF SCIENCE AND TECHNOLOGY – A USER'S GUIDE

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TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC) AND USERS OF THE ERIC SYSTEM."

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# PREFACE

This Lecture Series is sponsored by the Technical Information Panel and the Consultant and Exchange Programme of AGARD.

The storage, retrieval and dissemination of technical information are subjects of constant interest to information scientists and to others directly concerned in work of this kind. In the past they have not always been regarded with equal interest by those who are required by their duties to use the information itself. The Lecture Series is an attempt to offer guidance to the user of technical information.

The purpose of the series is to outline for the user of information systems the principles upon which such systems are based, and thus enable him to understand and more readily exploit their potentialities. The series includes presentations of general information on this subject and more detailed examples of specific scientific, medical and governmental systems.

Anthony Debons
Lecture Series Director

# LIST OF SPEAKERS

Lecture Series Director – Prof. Anthony Debons
Vice-Chairman
Interdisciplinary Doctoral
Program in Information Science
University of Pittsburgh
Pittsburgh, Pennsylvania 15260
USA

Mr Charles K.Bauer
Manager, Technical Information Department
Lockheed Georgia Company
86 South Cobb Drive
Marietta, Georgia 30063
USA

Dr Marta L.Dosa
School of Library Science
Syracuse University
113 Euclid Avenue
Syracuse, New York 13210
USA

Mr Fred S.Dyer
Scientific and Technical Information Officer
Rome Air Development Center (TI)
Griffiss Air Force Base
New York 13441
USA

Mr Edmond Howie
Associate Director
Knowledge Availability Systems Center
University of Pittsburgh
Pittsburgh, Pennsylvania 15260
USA

Mr Allen Kent
Director, Office of Communications Programs
University of Pittsburgh
310 LIS Building
Pittsburgh, Pennsylvania 15260
USA

Dr George-E.Unger
Head, Drug Information Centre
Farbwerke Hoechst AG.
6230 Frankfurt (Main) 80
Germany

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# PRESENT KNOWLEDGE DOMAIN OF SCIENTISTS AND TECHNOLOGISTS

By
A. Debons
University of Pittsburgh

## SUMMARY

The major concern of the lecture series is to establish an understanding of available data resources in several scientific and technological areas. The effective use of such data resources depends on some understanding of how information is generated, used and given to others. The discussion therefore probes the influence of organismic variables on our ability to acquire and process data. It also probes the direct use of the resulting information in decision making and problem solving. Our understanding of the way certain variables involved in these functions relate to the use of data bases is detailed in the lecture series.

We are all users of information. We are users of information from birth till death. Indeed, information as a process - that which MACLAP (9) called "a state of knowing" - is fundamental to life itself. Deny the organism the process of information and death ensues. But information is also a commodity - a matter of worth, of acquisition, and in Bacon's terms, "of power". As users of information we are concerned with both of these aspects.

The implication of what I have just said, for our present purposes should be made clear. Each of us in our personal and professional capacities is dependent on our ability to acquire, process and use data. Because of the many advances in technology that all of us are experiencing, our ability to produce data and process these data to information has increased many-fold. Yet, the human abilities required to meet the corresponding technological resources remain relatively static - despite the understanding about these human abilities that has emerged during the present century. This is the fundamental user problem, namely, to use any possible incremental advantage to match human abilities to the technological resources available. This match must occur at three levels: it must enhance man's information generating capabilities, his ability to use the information he produces, and his ability to transfer to others what he has generated and used.

We can expect that the production of data and information will continue to increase. With this state of affairs all of us have the responsibility to look for ways to increase our ability to use information effectively. Luckily, with increasing production of data and information, new ways of organizing these resources have been and are continuing to be made available to us. Bodies of knowledge have been organized so that mechanized handling of such knowledge is now available. It is the function of this lecture series to bring these means to your attention and to provide some guidance in their effective application.

The knowledge domain of scientists and technologists is vast and complex. We can only attempt to provide a sample, a segment of the total range. We have selected for the lecture series several main areas, namely, ecology, medicine, and the physical sciences. We will tap the knowledge domain gained from the space effort and attempt to detail the knowledge resources available from military and governmental stores. But again, these are limited domains, considering the many other areas that could be approached - education, economics, geography, meteorology, and many others. If our attempt in this effort were to be solely dedicated, however, to the explication of the several knowledge areas we have selected, we would fail to meet the objective of these lectures. The treatment would provide you with worthwhile skills in using the data systems, but would miss the more important objective of providing insight into the variables that are particularly pertinent to us as users, and which are significant in the entire spectrum of data and information systems available to us.

Let me be more specific on this point.

A data system consists of a data base and the related mechanisms and procedures, manual and/or mechanical which enable the user to transform data to information. The data base is an organized collection of coded events. Lancaster and Fayen (8) discuss the data base structure as "the organization of the information in the data collection to show the established logical relationships among the various types of data". I would revise this slightly; I consider the data base structure to be the organization of the data through which the transformation of data to information by the user can be achieved. I make this revision to emphasize my previous statement regarding the purpose of the lecture series. Indirectly, it defines what I believe the knowledge domain of the scientist and technologist to be. The data base is the independent variable in my way of thinking; information the dependent variable. Data is the stimulus, using the terminology of the psychologist -- information the response. The knowledge domain, or if you will the organized information domain of scientists and technologists, is therefore the total response repertoire, borne of the education, experiences, and views that influence his ability to transform data to that response we call information. Thus, when we say that Mr. X is informed, we use the term correctly; when he transforms data to information, he indeed is informed. He is in a different state than before he was exposed to the data.

The way that the data base is organized most certainly influences the way we are capable of transforming the data to information. Consequently, we should attempt to understand its structure and how this structure can be approached to suit our purposes. But data bases are a peripheral part of the knowledge domain. More fundamental is the response dimension.

While we are on the subject of response, let me go a step further in my thesis. I would like to suggest that you consider the acquisition of data as satisfying a need - the need being information. If, as I mentioned in my initial remarks, information is a requirement just like oxygen, this need must be satisfied. The satisfaction comes about through occurrences in the event world. After these events are coded; we identify them or call them data. The satisfaction of the need for data can be considered to have intensity, directionality, and all the attributes of other human satisfactions. Translated into our context this means that as scientists and technologists we have a need for food and water. This need finds its consummation in the processes of taking data from the event world, and transforming it into information.

But this concept has underlying implications.

First, each of us satisfies needs in specific ways. There are individual differences in the way we express and satisfy our needs. So, too, with information.

Second, the satisfaction of need is a social as well as a biological affair. The way we satisfy our needs is strongly influenced by the way others around us attend to their needs.

Third, needs are satisfied through the organized mechanisms (we call these systems) that are available to us. Needs are molded by the environment in which they find expression.

Fourth, needs are modified by education and training. We learn to moderate our requirements, expressing them differently and integrating them with other needs.

How can we recognize these needs we call information? More important -- how can we use the tools that are available to us in satisfying them? In a previous paper that I presented ( ) I identified several functions which I consider directly linked to these needs. To use anlogy, hunger is a state that finds its expression in the need for food. The many steps in the modification of that state entail the used several functions.

Similarily, information represents the end state of a process initiated as the result of a basic need. The process finds expression in several cognitive functions that are associated with this need including the following:

Extrapolation
Interpolation
Relation
Estimation
Evaluation
Prediction
Alertness
Integration
Verification
Translation
Transformation
Collation
Monitoring

In each of these functions, optimal and suboptimal conditions for the manipulation of data prevail at various times. The considerations in the use of data bases as presented to us by our speakers, are to be judged in the light of such conditions.

Now can we summarize the major points so far? The point I have been trying to convey is that the knowledge domain of our scientists and technologists has two fundamental parts.

First, it consists of the formal and informal ways that are available to us to collect data about the world and events around us. The data bases that will be explained to you in the lectures that follow will attempt to provide you with some of the formal ways. I will attempt a brief explanation of the informal channels later in this paper.

Second, the knowledge domain consists of ways of transforming data into information. This is important, and I will give further attention to this matter presently.

As I stated in my initial comment, if we are to achieve a match between technological and human capabilities, some synthesis of these aspects must occur. I referred to the three levels in which these capabilities are expressed - generation of information, use of information, and transfer. I would like to cover these three aspects in greater detail and thereby support the belief that an important feature of our knowledge domain is our ability to take what is given us in the event world in raw form and make information out of it.

At this point I should like to make clear that data bases are not information systems. They are components of an information system. The necessary and sufficient component of an information system is man; only through man can the full consumation of the data-to-information process occur.

Information systems permit the acquisition, transmission, and processing of data. Through these functions information is generated. For example, the human organism receives signals through its receptors. These signals are usually coded in binary arrangements and transmitted through the central nervous and allied systems to the cortex. These signals are processed at the critical level, initiating efferent impulses that lead to motor or cognitive responses. An information system, by definition, performs similar functions, except that it represents a technical, and not a biological, form of the process. An information system is a tool that facilitates the transformation function in man.

The conceptual gap between data bases, which are our concern here, and the information system I have presented, needs to be bridged. If we consider the user (man) as a polarizing factor, then our discussion should center around man's capabilities in using data bases. In particular, he uses data bases in generating information -- so that ultimately he could use the information in making decisions and in giving data to others.

Let us concern ourselves, then, with generation of information. By generation of information I mean the capacity that you and I have to acquire and process data. The avenue for acquiring data is through our senses. Perhaps we should ask, "Are the senses have a limit in what they can acquire? Are these limits independent of individual differences? In what way is acquiring data essential to the understanding of our capabilities in dealing with data bases, and how do information systems help? It would be best to explicate this last question first. The final step in the transformation of data is the depiction function, such as hard-copy read-out or an electronic display. In certain instances, this output is interactive, since it permits the user to directly influence the data transformations which are possible in the system. This generally occurs through an electronic interface, such as the electronic gun and a keyboard. To go back a step, acquisition is the reception of the signal, and this is always virtual. We never tap th real world. Acquisition can be organismic, or non-organismic. The organismic deals directly with the ability of the receiving mechanisms, the senses to receive the signal that is presented on the depiction mechanism such as display or loudspeaker. If the acquisition element is non-organismic, a mechanical device is implied. In some cases the energy level of the signal is important in determining whether the signal is received. But the energy level of the signal is not the sole limiting factor. For example, competing signals may interfere with the reception of any one signal; noise may inhibit reception. What all this means to us as users of information is that we use acquiring mechanisms to reach elements of the event world that may be available to us.

The acquisition function is bounded by the organismic (sensory) limits and also by the design formulations (hardware) of the system itself. The acquiring mecahnisms for information systems are mechanical sensing devices that restrict their acquisition within specifiable limits set by the designers of the systems. Radar is a typical acquisition device for Command-Control systems. Radars are limited in their capacity to recruit impulses based on the electro-magnetic spectrum involved. In typical data systems (or for some management information systems) inputs on logistic and personnel resources are generally acquired through human sensors that initiate card entries for specifiable events. These all can be considered as design bounded acquisition mecahnisms - the limits being set by the design of the sensory equipment used, or by the designer in the functional specification he establishes for the systems.

We shall leave the capabilities of the non-organismic (hardware) acquiring mechanisms to the engineers. Let us deal with organismic mechanisms. The organismic limitations for acquisition are significant in influencing our ability to deal with data.

We shall concern oursleves here with several aspects of the problem:

1. Awareness as Acquisition
   The ability to know when to acquire
   The ability to know where to go to acquire

2. Capacity or limits of Acquisition
   Given an array of objects that are related to need, what is the organismic capacity to acquire these objects?

3. Deterrents to acquisition
   When given an array of objects, some of which are related and some of which are not, what are the limits in sorting and acquisition?

Let us look at each of these aspects directly:

## Awareness

Awareness is the act of "taking account" of an object or state of affairs. Organismically, awareness relates directly to consciousness. Psychologists have discussed awareness in terms of threshold, that amount of energy required for an individual to respond to the energy level fifty percent of the times it is presented to him. To information scientists, awareness is "keeping up with the literature" . To you and me, as users of information, awareness means "being alert" to what is going on in our field. The "alert" issue seems to relate to the question of when we should be looking for items that are important to us as well as to where we should be looking.

Experiments that have been done on our ability to receive items for experience provide guidance to us in these matters.

First, the more you are exposed to objects (and this may refer to books, news items, and so on), the less alert you become to objects in general.

This is offset by the fact that more often than not, you are aware of things that interest you; this is referred to as "set". The threshold for these items are lower than for other items. Consequently, there is greater chance for you to be alert to them. But there is a gradual saturation point where even the items of greater interest become diluted in their ability together you attention. This would suggest that your exposure to data (or literature) should be paced to provide the greatest awareness potential.

Second, awareness is limited and often guided by anticipation. There is a bonding of events in that the existence of one event leads to awareness of the other. Scanning the data often leads you to connect one element to another. However, this is often at the conscious level. Scanning is a function that should attempt to do during acquisition. Though in the scanning process you may not realize what you are looking for, this doesn't necessarily mean that you are not becoming aware of other things which may be retrieved at a later time or for that matter, at the same time. This is referred to as "subliminal perception".

The third point does not really represent an organismic limit, inasmuch as it is partly derivative of the socialization process. It concerns our tendency to be guided by cause and effect relationships. In this sense awareness becomes a part of a drive to find the orginating influences. I like to refer this phenomenm as "information myopia", an inclination to believe that the farther away (in location or time: historically) the data is, the more important it is that you acquire it. This may represent a debilating influence, particularly if we acknowledge present trends in data generation. Much of the data available in contemporary literature is historic detail brought up to date. There is no need to search such history when it is compacted in current treatments readily available to us. Similarly, data that is available from one source can be found in many other sources--these latter sources perhaps being more accessible. This suggests a need for greater flexibility in our demands for data, and for stressing less tranditional and conditioned habits of tracing historical data to satisfy data needs.

## Limits of Acquisition

A user can handle only a certain amount of data through his senses. Given the fact that all the data elements are relevant and pertinent to him, how much can he effectively receive? This limitation is often referred to as "channel capacity". This is an extremely complex matter, and I can only touch on some aspects of the problem--those aspects that I consider to be relevant to the purpose of this lecture series. For example, we can consider the capacity of a single channel and its ability to handle the data. The other views look at channel capacity as including the total influences that may be impinging on the individual at any particular point in time. For our purposes, let us take the broader view, of channel capacity influenced by many forces.

Within this view, channel capacity is the ability of the sense mechanism to discriminate the output of the energy systems in the event world. Through our senses, we are more capable of making relative judgements about events than we are of making absolute judgements. For example, most of us can discriminate thousands of different colors on a comparative basis, but we can make absolute judgements about very few. In operational situations where we are given some standard, we do better in absolute judgements. But the number of possible discriminations we can make in this connection is not very high (from 4 to 9). The number of discriminations varies according to the sensory attribute or modality. In his famous 7 ± 2 paper, Miller (10) postulates a range of from 5 to 9 discriminations. What does this mean to us as users of information systems? These data imply that in absolute terms, our ability to discriminate items that come to our attention can indeed be quite limited.

With the great expanse of data introduced to our sensory channels in the form of titles, subtitles, and so on the flooding may in fact result in a complete breakdown in our capacity to respond effectively to what is presented to us. But there is one saving grace. We do have a better capacity to discriminate, and consequently to acquire, when we group or "chunk" data. This underscores to the need for information systems to facilitate acquisition by grouping data elements. This provides the greatest flexibility in the manipulation of data resources.

## Deterrents to Acquisition

We users are confronted with an excess of data, much of which is redundant or irrelevant; this introduces noise into the system. What are the facts and what can we do, as users? Much of our knowledge concerning noise comes from the human factors literature on visual tracing; the results are applicable to our purposes because the underlying interest is the change in human performance (which is also our concern).

At this point in our discussion we are not concerned with the concept of noise in the processing sense, that is, irrelevant material that inhibits the mission for which we are utilizing the information system. Rather, we are interested in the acquisition of data - come of which may be immersed in other data. Noise, in this sense, is the noise that may be available on a hard copy readout, or an electronic display, as the result of an electronic signal or a keyboard entry. Basically, the conclusion in this area is that the influence of noise is not as bad as we would suspect. Man has a good capacity for effective use of feedback mechanisms to correct the errors induced by the acquiring subsystems. Increasing the noise to the extent that the discriminative capacity becomes severely compromised, however, can lead to complete breakdown in the sorting function to which all users of information are obviously committed.

We need to move towards processing, another element in the generation of information. How do we transform data to information? Again this is an exceedingly complex and extended area, and I can only allude to those aspects which are germane to us at this time. I will consider the following.

First, data are stored in memory for later use. The storage function is part of the transformation of data to information. To what extent is the organism limited in retaining data? This relates to the user's ability to recall and recognize data that he has acquired. As users of data and data banks, we are constantly confronted with this aspect of our work.

Second, transformation of data to information involves the initiation and execution of algorithms that cluster data elements. Thus, we should ask: in what way is man better than the machine in processing data? There is a general temptation to suspect the ability of others, including the machine, to accomplish what we want. This weakness in delegation may impair our capability as users.

Let us examine these two points - first, man's storage of data. The overall storage capacity of the human memory is somewhere between $10^8$ and $10^{15}$ bits (6). This capacity is greater than that of any present computer. Actually, the capacity is even greater when we consider the combinatorial power of the human brain. The limitations do not occur in storage but rather in retrieval, during utilization. Nevertheless there are certain aspects of the storing of signals in the brain that are of interest to us. First, it is clear that certain data are stored in short term memory and others in long term memory. Experiments have shown that the loss of data after a short period follows a different course than loss which occurs over a longer period of time. Apparently there is considerable loss of data after the presentation of from 15 to 30 seconds. The material that is presented to us on the CRT may be quickly forgotten. Some of it will be retained, but the extent of the retention may be a function of the nature of the material that precedes or follows it.

Furthermore, memory is influenced by the organizational structure of the data at the time of the presentation. Data organization is a fundamental attribute of memory because the sequencing of the data, both temporal and spatial, most certainly influences its later retrieval.

Next I would like to discuss the aspect of utilization, which is the second level related to the match of information resources to human abilities. Data "becomes" information when we use it. Yovitz (12) claims that "information is data of use in decision making". Since we are all committed to the understanding of how we can apply available data resources to the problems and affairs of our vocations, let us see how we are limited in this capacity.

First, decision making and problem solving is directly linked to cognitive style and personality. The literature in the behavioral sciences is rich with data in support of several conclusions that are of direct interest to us. These conclusions are as follows.

1. The amount of data that some of us need to support our actions varies with respect to how we perceive the world. Those who are conservative in their estimations of events and their relationship to those events require much more data than those who are risk-oriented. In both cases, much more data is demanded than necessary; in the case of the conservative, the data provided is very seldom used. (7)

2. The way we solve problems and make decisions depends largely on the way we perceive the world--our orientations to it--our Weltanschauung. (3)

3. The work done by Newell and Simon suggest that individuals solve problems in sequential order--step by step. (11)

4. Decision making is very much influenced by stress factors (1) confronted by the user.

5. Decision theory suggests that the way we act on alternatives is to postulate the probabilities of possible occurrences; these probabilities are influenced by prior experiences, actual and subjective (5).

6. Individuals adopt certain strategies in their attempts to understand the attributes of the information available to them. (2)

What does all this mean for us as users?

It is my belief that the hope of a single design, a single algorithm for the design of information systems, is a myth - an impractical dream that should not be pursued. If there is any criterion for information systems or for data bases, it is that they should be as flexible as factors related to their operation will allow. Information is a dynamic process; a data system can only function well if it allows these dynamic processes to proceed appropriately for the environment and task at hand. When information is conceived as a commodity, then logistic consideration pertain and many of the laws of economics and marketing should be pertinent. But the issue at stake in this lecture series is not the data bases as logistic systems, but rather the user as an agent in the vital transformational processes that are important in the generation of information. What can we say, with assurance, about the user? He is truly the only resource that is presently available to make possible the transformation of data to information. What we will present is the data resources. From there, we hope we can combine the data resource with the biological resource that enables you to use the data effectively to create the greatest human power base possible - information.

Our third level is transfer; often, we refer to this as communication.

The data bases that will be discussed in the next two days serve essentially two functions. They are the means for organizing of a body of events, and the attributes and functions of these events. But more than this, they are means for facilitating the transmission and transfer of information. They are communication devices.

As users of the data bases, we should highlight certain factors in this discussion. First, the ability to get the most out of the data bases is dependent on the language, the kinds of questions you raise - the way you structure the language to get what you want from the data base. There is a need to think through your problem before approaching the data base. If you are using an interface to get to the data base - an information specialist, if you will - the problem is the same, although less intense. The information specialist has ways of exploring technical materials that would not be available to you directly. If the communication with the data base is on-line, that is, interactive through an electronic display, the problem of simplifying and directing your language is still important (Lancaster and Fayen). In any case, whether in an on-line mode or through a "filter" in the form of an information system specialist - the problem is the same, namely, to make maximum use of the power of the data base. Thinking your needs is essential. You must learn to communicate with the data base before you approach it. The lecture series will try to assist you in this area.

Next, mechanical data bases are limited by the capacity of the data base to respond to you quickly. Our knowledge from human factors tells us that if there is a delay time in the response of the system to your needs, negative reactions to the system will emerge on your part. You will become impatient, and there will be serious distractions. This suggests that some learning has to occur on your part to tolerate such delays, and the limits of the system's ability to respond to you.

Very often what you get from the organization of a data base might not be relevant to your own thinking style. You have to have the capacity to organize your thoughts so that, when you communicate with the system, you can organize its response into your own conceptual frame of reference. Thesauri can help, in this connection.

There are other factors which may inhibit communication. For instance, there is the possibility of your own timidity in approaching the data base. Knowledge of the data base and its potential value to you as a user will greatly reduce this timidity. This will be one of the objectives of the lectures which follow.

I am sure that all of us are cognizant of this next factor, but perhaps it bears repetition. Data bases are structured, more often than not, on logics that are not necessarily those of the user. In respect to on-line interactive systems, the disparity between the logical structures that is brought forth by the user and the data base may be significantly reduced to the extent that data file structure is not an important variable. In dealing directly with the data base, not on-line, the problem is of a different degree of severity. In the latter case, the user is required to exercise considerable flexibility in shifting between views of his requirements so as to achieve a match between the capacity of the data base and his needs.

There are other factors, of course, but time will not permit my going into them. I am sure, however, that they will be discussed within the context of our lectures, and also be made explicit in the exercises that we will jointly undertake.

Before I close, just a word about the program. The presentations that we have made available attempt to explicate the structure of a representative number of data bases that are of interest to you. Of course, there are other bases. What we would like to provide through the lectures is a sense of generality as well as specificity, that can be applied across a broader spectrum of data bases. I have attempted to sketch the general underlying concepts that pertain to the knowledge domain of scientist and technologists. Professor Kent will explicate some of the dimensions of getting to the information systems, via the problems inherent in raising the pertinent questions with an ever-increasing data base. Dr. Unger will provide you with an understanding of medical data bases. Dr. Dosa with environmental information systems. Mr. Bauer will discuss information systems pertinent to the physical sciences. Mr. Dyer and Mr. Howie will discuss systems related to the government: Federal systems. I am looking forward to these lectures, and to interacting with you in the next two days.

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# GENERATION, USE, AND TRANSFER OF INFORMATION

by
Allen Kent
Director, Office of Communications Programs
University of Pittsburgh
Pittsburgh, Pennsylvania 15260
U.S.A.

## SUMMARY

The information explosion has produced an effect that has not been widely recognized. The inability of individuals to read all potentially relevant material has changed the nature of questions asked. Previously questions were typically based on a "recall" mechanism. Now, questions are asked more frequently that relate to a problem, with the aspects of the question derived from the problem at hand rather than "recalled" from previous contact with specific items of the literature.

Information systems have attempted to respond to this change through deeper analysis of materials, and "coordination" of desired aspects of subject matter using computers. The need for "connection" between the terminology of questions posed and the available "analytics" has become more critical. More precise control of vocabulary is needed, leading to the construction of mechanisms such as thesauri.

But systems are not working as well as expected, leading to the identification of fundamental problems relating to a lack of understanding of the information transfer process.

In man's worldwide struggle to control his environment, to survive in the face of destructive external forces and to better conditions for himself and for his neighbors, decisions must continually be made. Such decisions depend fundamentally on the wisdom of the decision-maker and on the quality and relevance of information brought to the attention of the decision-maker.

Here, then, is a fundamental rationale for man and society to accumulate and organize information relating to past accomplishments and failures.

Pressure to increase the effectiveness with which society's available knowledge is brought to bear on an increasing range of decisions that must be made in an increasingly complex environment is a natural concomitant of growth. Pressure to facilitate the dissemination of information to an ever widening range of individuals, groups, and institutions over barriers of time, space, and differences in sociological, political, and economic patterns is a second logical expectation.

Educational institutions, libraries, the societies of the learned professions, and various other mechanisms have evolved into being as formal social instruments for accomplishing one or more of the unit operations involved in the task of communicating and transmitting information and records from civilization's "memory."

Traditionally, the "memory" of our civilization has been recorded in a form that was quickly stored, once generated, in a categorization that could match, relatively effectively, the intellectual frameworks of the users of this memory. In the past, this framework, once acquired during the educative process, remained relatively stable, and was adjusted by the empirical feedback of informational experiences.

For several centuries, the "memory," represented by the library, could adjust with some leisure to this evolutionary change.

However, since World War II, there has been a startling and drastic reduction in the time scale of information marshaling for decision-making and control. This change corresponds to the increases in rates with which competitive activity, international aggressive action, and changes in public opinion can deteriorate economic, military, and political situations. There has also been a dramatic increase in the amount of information that is freely available (that is, published in one form or other). This leads to the phrase: "information explosion." The "explosion" has three dimensions of frustration:

(a) The impossibility of an individual reading and remembering all of the literature that has a reasonable probability of being of use later.

(b) The economic impossibility of individuals or their organizations processing for later retrieval the majority of literature of possible pertinent interest.

(c) The inadequacy of traditional library methods and tools in coping effectively with the detailed requirements of individuals in identifying information pertinent to a given problem.

Further, the increasing complexity of the problems of society has led to a need for information from an ever increasing number of fields. This has resulted in the need to achieve insights into otherwise obscure or uncertain situations through the use of large amounts of fragmentary information from widely scattered sources.

There was a time when an educated person, particularly in science and engineering, was expected during his graduate schooling to read essentially all of the previously published literature pertaining to his field, and then to continue reading currently all that was published. It was assumed that this procedure was necessary in order to provide assurance that the productivity of the graduate would not be blunted by lack of knowledge of significant developments.

Accordingly, when reference to previously published literature seemed important, the graduate, now professionally active, could rely on his memory to specify subjects which could be used to recall relevant material from libraries or personal collections. This type of "information retrieval" was typically based on a memory recall mechanism which generally permitted the rapid identification of the desired materials.

A subtle change in the memory recall mechanism began to take place as the volume of published literature reached the point at which the professional could no longer read, personally, all of the primary material that was related to his interests. More and more, the professional was forced to delegate to others (for example, librarians) the task of organizing for later retrieval the new materials that became available. The professional could no longer depend on his own memory to recall subjects that he had previously perused, since the task of perusal was delegated to others. Rather, when information relevant to a current interest or problem was desired, it became necessary to use a memory external to the individual, that is, the "collective" memory of the systems devised by catalogers and indexers to whom had been delegated the task of materials organization and storage.

Uncertainty resulted with regard to how such organization was performed. It could have been predicted that this uncertainty would result, since the indexers could not be expected to be able to predict every point of view from which information would be requested. Factors such as differences in orientation, background, and experience between indexers and information users inhibited the "perfect" analysis and organization of materials so that retrieval of relevant materials could be accomplished in a fail-safe manner.

The reaction of the indexers was to analyze more "deeply," that is, to record more and more subjects which could be used as reference points during literature searches. This reaction, together with the increasing volume of published literature, required increasing commitment of resources, both human and economic, to assure adequate analysis of all the materials that might be of subsequent interest to the professional. Furthermore, the traditional means for storing the materials, as well as the indexes to them, were strained. The volume of materials, stored in traditional form, required more and more space commitments. The traditional alphabetic indexes, recorded in either printed or card form, grew in size to the point where they became quite unwieldy. Furthermore, although reference to individual subjects recorded in the alphabetic index could still be performed effectively, another problem emerged.

As soon as the professional could no longer rely on his recall mechanism, not having read much of the material that was being processed by the indexers, the questions posed to the systems began to change in character. There was an increasing tendency to specify, instead of well-defined subjects, a number of characteristics of the subject of interest, all of which would need to be present in a source material bef it should be identified as relevant. This meant that, when using an alphabetic index, one would have to compare the entries listed under several characteristics in order to discern whether there were any references in common--a difficult and time-consuming procedure.

An example of such a problem appeared early in the chemical literature. If it were assumed that indexers recorded entries specifying not only a chemical compound but also the individual properties of the compound, then a chemist interested in all the compounds (names unknown to him) which exhibited a particular set of properties would be required to consult the index for each of these properties, followed by comparison to determine common references--a tedious task, considering the number of volumes of indexes of Chemical Abstracts that would have to be so manipulated.

But there would be no certainty that the chemist, in specifying properties, would use terminology identical with that used by the author of a paper in describing the same properties or by an indexer in recording the properties for later retrieval. The traditional library technique has been to use standard terminology for all such index entries. This was appropriate as long as these standards were known by those who would use the indexes. But when these were not known, cross-references were provided from those terms known to the user to those used in the index as "standard." The simpler cross-references gave way to the more detailed thesaurus, as more centralization in services required more users to help amortize the capital costs involved, each user bringing his own perceptions, paradigms, and vocabulary, further complicating the terminology-control problem.

Merely providing a cross-reference (or providing a thesaural relationship between words) says nothing about whether the referenced items list information that is all relevant. As a matter of fact, although the provision of more and more such references tends to increase the probability that relevant information is not neglected during a search, there may be a tendency for more and more irrelevant information to be identified along with the relevant. Carrying this situation to a ridiculous extreme merely to make a point, it is possible to relate each term to each other in an information retrieval system, thus identifying all relevant information in a system but carrying with it the entire remainder of the system which is not relevant to a particular problem for a particular user at a particular time.

Since no quantitative technical solution to this problem has emerged, two alternative reactions have set in, decentralization and specialization.

In order to assure that attention to individual users' problems is provided on as close to a face-to-face basis as possible, permitting adequate interpretation of a question and adequate review of systems' output to screen out irrelevant information before making it available to a user, the large centralized systems have tended to become responsible more and more for input to the system (acquisition of source material, analysis of material, terminology control, recording of results of analysis on a searchable medium, and storage of the full source document in economical reproducible form). Then copies of the resulting material (e.g., indexes and microcopies of documents) are made available locally so that exploitation (searching, reviewing of output, and provision of copies of documents) can be handled in many local institutions.

In order to assure that analysis and terminology control more nearly match specialized user requirements in specific subject fields, the development of specialized information centers has been encouraged. The cost of such specialized activities may be considerably higher than that of wholly centralized operations during input phases, but the efficiency and effectiveness of exploitation is expected to overcome these increased input costs. The approach is not an unmixed blessing, however, since users who have interdisciplinary problems may require searches covering the subject matter of several such specialized information centers, causing compromises in the effectiveness of terminology control mechanisms built into each which are not mutually compatible.

Perhaps, then, a mix between centralized, decentralized, and specialized activities may emerge as a compromise. It may be foreseen that the centralized unit may be responsible for wholesale input operations and for stocking the decentralized units that wish to exploit the entire system locally. Furthermore, the specialized unit may rely on the centralized unit to identify source materials which may then be reviewed in more detail so that specialized services may be provided as required. Some institutions may then wish to have available on a decentralized basis the output of one or more of the specialized centers, for local exploitation.

The intellectual problem of rationalizing the services that cut through both the specialized and centralized services, providing a network for effective exploitation, has not yet been resolved.

When it became apparent that more literature was being published and indexed than could be consulted effectively by persons desiring information relating to a problem, one of the early reactions was to attempt to improve the speed with which the searches could be conducted. Accordingly, computer-like devices began to be applied. It became possible to scan indexes much more quickly, but with no resulting increase in effectiveness of searches. An alphabetized index could often be consulted much more readily by a human, as a matter of fact, since reference to a single subject required examining only the appropriate subject heading in order to identify desired information, while the computer was required to scan the entire index in order to locate the same heading.

It was only after the trend to analyze more "deeply" and to cross-reference more liberally began that the application of computer-like devices began to show reasonable efficiency.

Let us consider the problem of consulting an index when a hypothetical question is to be answered in the field of medicine on effects of blood coagulation disorders on heart disease in children. Consulting subject headings such as "blood coagulation disorders," "heart disease," and "children" might be a first step to the discovery of which references are in common to all three. Here, the human might not feel this task too burdensome. However, if a more exhaustive search were desired, reference to a number of cross-references for each of these subject headings would be advisable. An example follows:

Blood coagulation disorders ($A_1$)
  See also
    Blood coagulation ($A_2$)
    Anticoagulants ($A_3$)
    Thrombocytes ($A_4$)
    Blood platelets ($A_5$)
    Hemmagglutination ($A_6$)
    Blood viscosity ($A_7$)
    Blood diseases ($A_8$)
    Hemostatics ($A_9$)
    Hematologic diseases ($A_{10}$)

Heart disease ($B_1$)
  See also
    Cardiovascular disease ($B_2$)
    Cardiology ($B_3$)
    Cardiac arrest ($B_4$)
    Heart ausculation ($B_5$)

Children ($C_1$)
  See also
    Infants ($C_2$)

The human would then have to consult 18 subject headings ($A_1$ to $A_{10}$, $B_1$ to $B_6$, $C_1$, and $C_2$) and determine whether any published paper had been referenced under any one of the following combinations of headings:

$A_1$ and $B_1$ and $C_1$
$A_2$ and $B_1$ and $C_1$
$A_3$ and $B_1$ and $C_1$
$A_4$ and $B_1$ and $C_1$
$A_5$ and $B_1$ and $C_1$
$A_6$ and $B_1$ and $C_1$
$A_7$ and $B_1$ and $C_1$
$A_8$ and $B_1$ and $C_1$
$A_9$ and $B_1$ and $C_1$
$A_{10}$ and $B_1$ and $C_1$
$A_1$ and $B_2$ and $C_1$
$A_2$ and $B_2$ and $C_1$
$A_3$ and $B_2$ and $C_1$
etc. for 120 such combinations.

In this case, a computer could, more effectively than a human, conduct a search of an entire file which would be specified logically as:

($A_1$ and/or $A_2$ and/or $A_3$ and/or $A_4$ and/or $A_5$ and/or $A_6$ and/or $A_7$ and/or $A_8$ and/or $A_9$ and/or $A_{10}$) and ($B_1$ and/or $B_2$ and/or $B_3$ and/or $B_4$ and/or $B_5$ and/or $B_6$) and ($C_1$ and/or $C_2$).

Although the cost of operating a computer to search for responses to a single question may be quite high, it becomes possible to batch questions in such a way that the cost is amortized over many questions.

It would seem from the foregoing that an institution should accumulate computer-searchable files from many centralized and specialized information-processing activities, to insure the ability to respond to inquiries from patrons.

However, an increasing number of institutions are demonstrating the feasibility of using time-sharing computer systems, with remote access to a central computer possible from inexpensive terminals. It is therefore possible to hypothesize access from any remote station to the computer-based systems of both the centralized and specialized varieties. Would it then not be feasible to avoid the expense of updating many decentralized units throughout the nation in favor of supporting a network of centers communicating via computers?

The criteria for evaluation of alternatives do not relate merely to computer and communications economics. Rather, one of the critical criteria seems to be the proximity to question askers of experienced specialists who can interpret queries and who can interact effectively with the subject matter of the systems in order to produce meaningful responses.

Modern communication technology offers the opportunity to transmit information in the form of data, voice, and images. Using this technology, the information resources of all organizations can be shared by permitting remote inquiry through an appropriate network system. The availability of time-sharing computer systems with their ability to tie into network systems makes it possible to contemplate an inquirer sitting at a remote console interacting with a multiplicity of information resources in real time. In considering how to translate theory into practice, questions such as the following must be addressed:

1. How can the differing philosophies of indexing source materials be rationalized when several resources are to be exploited to satisfy a single inquiry?

2. What criteria would inquirers use in judging relevance of information provided interactively when networking systems employing modern communication technology are used?

3. What will the behavior of an inquirer be if he has the opportunity to conduct information searches personally through a console? What training problems will be involved?

The pressures for greater and greater penetration into the subject matter of source materials have been evident as the quantity of published information has reached the point at which traditional classifying and indexing methods are not able to provide literature search results with the precision, relevance, and quantity limitations being demanded.

This has led to the requirement for precise specification of problems and questions of inquirers, which in turn demands corresponding means for precise specification of the subject matter of the source materials. This consideration has led to increased pressure for subject analysis expertise which approaches the expertise of the inquirer. On the other hand, the personnel requirements for processing the increasing quantity of source materials have not been matched by available skilled manpower. Consequently alternative methods of processing have been considered, proceeding successively through the use of:

(a) Generalists rather than specialists

(b) Automatic means for analysis of information, involving either portions or the entire text of the source materials.

A study of the results of application of both of these methods indicates that imprecision and inconsistency in analysis are not avoided, leading to uncertainty in the results of exploitation of large files. Accordingly, other means have been sought to overcome the consequences of this uncertainty. Explorations have resulted in the development of various vocabulary control and search strategy techniques. Testing and evaluation of these techniques have become a matter of increasing interest, leading to the identification of increasingly fundamental problems on:

1. The nature of information transfer from source materials to the inquirer

2. The criteria for relevance judgments of inquirers, and their dependence on incremental learning

3. The nature of concept formation

4. Most basic: the learning and thinking process.

The foregoing has stimulated reexamination of the traditional libraries and the very significant investment that has been made by society in their development and maintenance. Increasing demands for library service, even of a traditional nature, have led to investigations of how new tools and communication systems might streamline these functions, which, despite the growing importance of information storage and dissemination centers, still is the main instrument of society for providing democratic access to recorded knowledge. The result has been the application of computers and other data processing equipment to the control of circulation records, serial records, and even to the conversion of catalog information to machine-processible form.

Communications technology has been exploited in connection with interlibrary loan procedures (the traditional library response to resource-sharing requirements). The location of desired materials has been facilitated by the mechanism of almost real-time communication systems such as teletype. In addition image-transmission systems are being considered for the provision of copies of materials without physical removal from existing collections.

Although machines have been used in the library for some time in order to make more efficient the job of running the library, mechanized information retrieval in the library has only recently become a factor in planning user services.

New programs are being designed to respond to the problems incurred by the information explosion by hypothesizing that the library which is to serve future generations is more than bricks and mortar. It will not be useful if it is to be a book warehouse--manned by book keepers. Rather, the library of the future must be created as an organism for performing work, for providing service, and for conducting research. This organism will be responsive to the changing requirements of a dynamic field, with responsibilities in education, in research, and in practice. The most modern and flexible mechanisms will be available for exploiting recorded knowledge in the interests of professional advances.

The director of the library of the future will be a library and information scientist, an educator, and a research director. He will draw about himself a constellation of specialists from a number of professional disciplines.

The articulation of such programs is based on the thesis that there is need for access to recorded knowledge that must be satisfied by providing rapidly, conveniently, economically, and with precision, that portion of the current or previous literature that will be useful:

- to a particular individual
- at a particular time
- for a particular problem or interest
- and in a form that is useful to him

regardless of

- where it was generated
- in what form or language
- or how it must be located and processed.

The utopian dream is to have information available on the day of publication, neatly translated into one's mother tongue, and packaged in quanta which are of infinitely variable size and content.

The translation of this dream into a program involves changing concepts of information handling. Some of these concepts are discussed in the following:

a. Information as a Physical Commodity

Library materials, including books, periodicals, and reports, have traditionally been stored physically on shelves and selected on a "custom" basis, either by library staff or by the reader. In more modern terms, the significant amounts of library materials to be moved into and out of storage can be considered from, say, an industrial engineering point of view as:

(1) a warehousing and materials handling problem, with selection, delivery, and return to storage conducted mechanically

(2) a manufacturing problem, with materials stored in microform, and access provided locally and to distant locations through:

  (a) provision of returnable copies by mail or other physical means of transfer

  (b) provision of disposable copies by mail, or by telecommunications techniques

  (c) transmission of materials by means of television techniques with option of preparation of copies locally from the face of cathode ray tubes

  (d) stocking of subwarehouses with microform copies and providing access to information via mail or telecommunication media.

b. Information Retrieval as a Data Processing Problem

The available stockpile of information can be considered in modern terms as a data processing problem, with various types of equipment available for manipulating indexes to the physical storehouse of information from a multidimensional point of view. By this is meant that source documents may be characterized from more than one point of view and also identified for delivery by combining more than one aspect of subject matter--by applying clerical, mechanical, or electronic means to perform selecting and correlating operations.

c. Information Retrieval as an Intellectual Problem

In traditional terms, the library activity has been an art, with analysis of documents and reference services considered to be techniques which are learned through apprenticeship after suitable training. However, the greater demands being placed on the library have resulted in the realization that specialists in other fields can make a significant contribution to the intellectual problems facing the field. Accordingly, there has been an infusion of linguists, logicians, mathematicians, electronic engineers, psychologists, and other specialists who have been considering means for the solution of theoretical and practical questions that are encountered in communicating via the written record. These specialists are involved in the forward research work leading to the development of more sophisticated automatic information retrieval systems.

d. The Library in Terms of Technical Processes

A library represents different things to different people. To many library staff members, the library consists of a number of technical processes involving: (selection of books, periodicals, or other materials) ordering of materials; binding; cataloging; copying; etc. These technical processes can be considered from an "engineering" point of view as unit operations, which are conducted in a "production" environment, with modern business methods being applied to carry them out and to keep track of them. Various methods of automation are now being considered for each technical process of the traditional techniques and for many of the unit operations newly identified in more modern approaches.

The view of the library in modern terms permits the establishment of a "one-stop" service concept which would provide entree for a user to all or most of the data bases relevant to his interests, whether stored in a traditional library or in computer-processible form.

This concept is achievable without the need to create major data bases, or the services related to them, de nova. The trick is to interrelate, on some basis or other, with many discipline or mission-oriented services available from commercial organizations, government agencies, professional societies and universities. This relationship would involve acquisition of, or remote access to, search-ready files, often involving the use of computers for exploitation purposes.

A researcher attempting to access the journal literature is faced with two critical problems:

- Obtaining alerts to information that is relevant to a particular problem, regardless of his level of sophistication about the subject;
- Obtaining access to relevant documents in a reasonable period of time, regardless of where those documents are located.

As the quantity of published information, the interdisciplinarity of scholarly activity, and the cost of acquiring materials increases, these problems become more and more pronounced. They are unlikely to be solved by individual action alone, since the budget of a single institution is clearly inadequate to permit purchase of all or even most of the published information that might be of later use in that institution. Furthermore, it is impossible to predict, with confidence, what materials will be sufficiently useful over time in a given institution to warrant their purchase.

The problem of alerting users to relevant information is a traditional one. An individual does not really know what is relevant to a problem that he has in his mind until he is exposed to things to which he can react, saying this is relevant or not. On the other hand, indexing systems can do no more than predict what will be relevant to a user, based on an analysis of the subject matter. In addition, they must predict the meaning words will have to a user, thus further confounding the problem. It is clearly impossible to develop precise depth indexing, much less to absolutely control vocabulary.

Stimulated first by user frustrations in being unable to exploit the conventional printed form of indexes, and later by increasing costs of traditional processing and publication, the development of information storage and retrieval systems for the journal literature led to rather useful mechanisms for alerting users to potentially interesting information. But the libraries serving those users are even more hard pressed to provide the journal literature to which users are alerted. When desired journals are not held in the library, interlibrary loan procedures can be instituted, but these transactions cannot usually be completed quickly enough to satisfy users.

The obvious response to this challenge is a computer and communications network which would make the computer-based information services available on a cost-effective basis, provide real-time delivery of relevant documents to which users are alerted, and substantially reduce the volume of acquisitions needed at individual libraries. Before such a network can become operational, however, it appears that it will be necessary to pursue sub-steps that show a likelihood of resolving the important technical, administrative, and behavioral issues posed by such a network.

The technology that permits the sharing of resources in one part of the world needs only the addition of satellite communication technology to fully democratize access to information wherever generated.

In this regard it may be remembered that this technology was hypothesized in 1945[1] and 1955[2] in two alternative views of the information systems that would produce the resource sharing objectives described.

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[1] V. Bush, "As We May Think," Atlantic Monthly, 176, 101-108 (July 1945)

[2] V. P. Cherenin, "Certain Problems of Documentation and Mechanization of Information Search," U.S.S.R., 1955

In the paper cited second, Cherenin concluded his discussion as follows:

> "Let us remark that, in spite of the fact that the information service of the future described above is quite fantastic, all the technical units required for its realization are in existence at the present time and being constantly improved."

And so, in 1974, we can suggest that the environment we live in calls for a new approach toward handling information--an approach more in keeping with the needs of our total world rather than a patchwork of parochial interests.

Our contention is that we currently have the talents to achieve our objective; that the technical problems can be overcome without straining the state of the art.

We live in an era characterized by tremendous scope of institutionalized activities and a multiplicity of complex problems in almost every area. The solution of these problems requires, in addition to exceptional human talents, the best that information technology has to offer.

The human talents, if they are to be kept productive, demand the availability of relevant information about the environment in which organizations operate; relevant information about day-to-day operations; relevant information that is accurate, complete and effectively communicated; information which is directly relevant to the administration of institutions, and providing their personnel with the time to direct more of their energies to the unsolved human and social problems of our society.

No organization can go it alone in generating or acquiring all of the information that may be relevant to it. Some try to marshal the information effectively and bring it to bear on the solution of given problems; few succeed in getting all or most of the information that is relevant to a given problem; almost none succeed in doing the job economically.

# INTERNATIONAL MEDICAL INFORMATION SYSTEMS

Georg E. Unger
Farbwerke Hoechst AG
Drug Information Centre
6230 Frankfurt/M. 80
Germany

## Summary

The flood of information especially in medical sciences can with no means, and especially not with the well-known conventional means, be accomplished today. Even the creation of localized medical information systems can not cover the demands the medical profession is bringing forward. With the use of computers new ways are opened. Various methods have been developed in order to analyse, organize and evaluate the present voluminous flood of information.
It is therefore necessary to find a concept for a worldwide medical literature information system with possible economic realization.
The lecture deals with the communication between existing printed information and the medical profession in all fields of this science. A new automated on-line terminal-oriented storage and information retrieval system is discussed on a worldwide international basis.

Medical literature information is one of the disciplines of computer science in medicine. We all know about hospital information systems, diagnostic systems, computerized medical statistics, research systems and so on. Due to the fact that the discipline "computerized medical information system" is new and growing to a vast extent we can only define it provisionally and approximately. The whole range of medical literature documentation in medicine has very close connections and transitions to parts of the computer science branches. A substantial knowledge of medicine is brought into this field and furthermore enlarged by the methods of data processing. There will be no branch in medicine which is principally not connected with data processing. This discipline is very closely connected with statistics and documentation in theory as well as in practice. Its limitations towards cybernetics and to "biomedical engineering" are fluctuating. Another part of its scientific basis is to be found in applied mathematics. In its routine application the rationalization of hospitals plays a certain role. Only the future will prove which empirical differentiations of data processing in medicine will remain stable and prove institutionally valuable.
The lack of an accurate definition at the present moment - as it is also in other modern disciplines - should not mislead to the conclusion that this domain would not have its own independence. This independence is, as well in research as also in teaching or in its practical application, at present clearly manifested.
The organization of computer science in medicine could preferably start with the systematics of the various application ranges or from a systematics of computer science. Significant aspects are research, teaching, patient care, hospital administration, and many others. All these points are to a certain degree differently important in their way of application. Due to the fact that these different disciplines will in the future differentiate themselves from each other, we will discuss them in short:

### Statistical and mathematical evaluation techniques

Here is a vast, wide field for the application of EDP in medicine. Computers changed medicine profoundly. Routine calculations and methods are possible, resulting in an exactness that has never existed before. New dimensions in medicine due to quality and increase in exactness especially in medical research have been created.

### "Patient care" - administration and basic documentation

Doctors in hospitals can in various regions be supported by a computer in their daily specific medical duties. Patients' history sheets, clinical examination, diagnosis and therapy are, for example, such facts. Within this support is the rationalization of the hospital from admissions to settling accounts, whereby medical and organizational procedures are handled by the same system.

### Computer and diagnosis

The realization of various theoretical models for diagnostics are made with the help of EDP, since mostly quite complicated calculations have to be made, and processing of voluminous material can not be made with any other medium than the computer. A further advantage is that the computer never forgets to point out whenever exotic diseases or rare examinations have to be made.

### Poison information centres

As a part of computer diagnosis larger information systems, such as poison information centres etc., are well-known. Especially regarding various aspects due to poisoning, the diagnostic support by automatic machines is quite important and already well established.

In order not to prolong the addition of possibilities of the computer in medicine we will just name the topics which are in our opinion of significance in medicine:

automated training in medicine,
definition of data structures,
development of formal languages,
automization of the chemical laboratory,
biosignals,
nuclear medicine and radiology,
intensive care units,
biomedical engineering,
biological examinations via on-line service,
pharmacokinetics,
chemical pharmacological examinations, side-effects,
statistical evaluation,
automated multiphase health testing,
medical data bases.

Here we come to literature information systems. All disciplines of the sciences have one imperative fact in common, the optimation of literature with the help of EDP. The permanent growing number of publications can only be managed whenever it is possible to have decisive information stored in extensive data bases which can be searched automatically and inform the medical profession whenever such information is needed. Scientific examinations about the optimal organization structure of stored datas as well as the improvement of retrieval systems can only improve the already existing systems.
It therefore becomes necessary to enable many users to be connected internationally to a literature information system as soon as possible. This fact naturally creates quite a number of problems which need a very intensive analysis, should a literature information system become internationalized. The already well-known literature information systems, f.e. MEDLARS and EXCERPTA MEDICA are systems which penetrate fairly deeply in their retrieval and search functions, but it is necessary that additional special literature data systems, according to the various medical disciplines, should be set up in order to cover smaller sectors of the total of medical literature, and that these smaller literature information systems can cover the detail better, should however be compatible with a master data base.

## Present situation

The permanent increase of scientific publications, the so-called "information explosion", influences to quite some extent the daily work of the medical profession. The exponential increase is easily demonstrated with a few figures:

at present, in the field of biomedical literature, about 14 000 to 16 000 journals are published per year, with about 700 000 to 1 000 000 single publications; this means about 2 000 to 3 000 publications per day.
Today about 30 000 diseases are known, annually about 400 to 600 new ones can be added.
Doctors today have about 40 000 to 60 000 medical drugs at their disposal, this is a tenfold increase in the last thirty years.
Newest calculations state, that every 24 minutes a publication in chemistry is written, and that every 34 to 35 minutes a medical publication appears.

## Time-saving and cost-calculation

A few figures:

Generally, every scientist doing research needs up to 60% of his working time to procure information.
There is practically no scientist who can read more than 5% of the original literature in his field of interest.

"Today it is even easier to rediscover a well-known phenomenon for the second time than to read and find the already published discovery in literature." This is what the physicist Bernal said in 1954.
The information flood leads thus to a considerable increase in information as well as to a lack of it. Accurate knowledge, i.e. finding the correct information means a considerable time-saving and a considerable saving of cost. "Not more, but the right information is needed."

These few introductory words show which demands have to be put to an international medical literature information system in order to follow up all tendencies in modern biomedical and chemical-pharmaceutical research.

Private enterprises, especially the pharmaceutical industry, have developed themselves various methods to eliminate the shortcomings encased in the "flood of information". A worldwide biomedical literature and documentation system will be discussed hereafter.

## Retrospective aspects of literature documentation

Up to now we have used a commercial punchcard system with somewhat complicated coding procedures, combined with reviews and reference lists. Since 1964, however, we have accumulated about 3,5 mio punchcards. Owing to time, space, and personnell, it is impossible to work through the entire stock during one search. The result of our literature searches became too small for research, clinical testing, and biomedical information, and can therefore no longer be considered of optimum value. No allowances are made for a number of modern bio-medical view-points which are essential in a modern retrieving system - i.e. the cost of public health services, biometric methods, work hygiene, occupational diseases, social medicine, preventive medicine, rehabilitation, plastics in medicine, air travel, environmental protection and hygiene, and many others, all on a world-wide basis.

The hierarchical classification is faulty, can not be developed, and is unsuitable for modern computerized data processing. Terminal on-line retrieval is not possible.
Using the conventional system, it is impossible to comply in a determined, orderly and controllable way with its conditions; for example registering new and conventional drugs in individual countries, etc. Without using data processing methods, it is practically impossible to obtain coordination in time between clinical research departments and a net plan. Summarizing the essence of what has been said so far:

1. a conventional literature department is scarcely capable nowadays of reading and classifying periodicals and formulating inquiries.
2. Reference punchcard systems cease to be effective and accessible when approximately 250 000 cards have accumulated. Punchcard systems may be adequate for individual medical specialities, but a large medical literature information centre is physically unable to handle and control them.
3. About 4 000 periodicals have to be processed by conventional methods. This is practically impossible without a very large staff, to say nothing of a literature service and an information service to the medical profession.

Information demand worldwide

An information system which has to deal not only with its own data (reports, abstracts, summaries) must also be able to use commercially available data bases which can differ in their quality and structure quite considerably. In order to use the information in an optimal way, qualified automated documentation procedures have to be used.

The introduction of an automated documentation- and information system in medical sciences and in medicine necessitates strict adherence to some points:

1. the data material (own documents and commercialy available material) must be tested centrally by the information centre as to its contents and has to be brought into an automated, readable form and context.
2. The documents have to be centrally stored and must be available for on-line retrieval.
3. The user requires rapid availability, i.e. short answer-time and up-to-the-minute information, which in turn depends on the degree to which the above criteria are followed.
4. Great accuracy is required, in order not to include any non-essential material, or allow an information-loss.

Of course, a computerized documentation and information system must satisfy the above requirements.

Organization

The introduction of EDP media into medicine naturally requires a certain organizational restructuring. Growing sciences, such as medicine, are governed by cybernetic classification principles. Beyond a certain size, rationalization is an emergency solution only and partial automation becomes necessary. This type of reorganization is not subject to a decline in the internal efficiency of automated literature information systems and does not in any manner alter the basic structure of information in medicine.

Introduction to a biomedical information system

The technical development in electronic data processing machines, with the possibility of on-line systems in automated documentation systems, as well as the offer of various information services to produce available medical data, made it possible in 1970 to introduce the already mentioned terminal-oriented storage and information retrieval system which is called Biomedical Information System.
Data material in differentiated forms is today already available on magnetic tape, for example Biomedical Abstracts, Chemical Biological Activities (CBAC), Excerpta Medica, Derwent-Ringdoc, Toxicon, International Pharmaceutical Abstracts, etc. These literature services are somewhat expensive, are, however, already pre-selected in their various aspects and, coupled with a good automated retrieval system, will give excellent results.
At present we have access to about 4 500 biomedical periodicals:

> This is about 28 000 individual issues per year or 250 000 to 300 000 articles or 2,5 mio pages, including approximately 250 000 abstracts, with index words, bibliographic information, and instructions which shall be discussed later. The total amounts to about 200 mio bytes.

The thesaurus contains a computerized dictionary of about 200 000 words. As a result of the introduction of the IBM/370 series with the data disc-storage 3330, the total word storage has been increased to 2 mio words. At present our data base contains about 50% generic names.
The thesaurus is based on:

a) primary terms,
   approximately 150 000 different essential concepts, such as diseases, pharmacological and generic names. Each primary term has a six figure code number. Numerical and alphabetical computer lists are provided in our data station. At present, synonyms of the primary terms can be referred to in a print-out. A display unit will later be used.
b) secondary terms,
   non-standardized, supplementary terms such as trade marks and names of companies are designated under secondary terms.
c) tertiary terms,
   general terms such as the species of the experimental animals, nature of application, etc. are shown in the list of tertiary terms.

The synonym list is subdivided into:

a) complex terms (such as trade marks and generic names),
b) language (differences in different languages).

Most diseases are described in the literature under several different synonyms. The same

drug is often listed under many different names. As the tragedy of thalidomide most clearly showed, a drug can not be rapidly identified unless it has a universally understood and accepted name: that is, an international non-proprietory name. Equal confusion exists in the medical sciences. Misunderstandings arise not always as a result of any disagreement in principle, but simply for semantic reasons. This situation obviously hampers the effective retrieval of information. It is clear that important observations are lost, simply because they are indexed under different synonyms.
Synonyms account for nearly half of the medical terminology in any language. Some of the terms used are obsolete, many incorrect, and others little used except in specific geographic areas or by particular schools of thought. For instance, candida albicans is discussed in the literature under more than 170 different synonyms. Every clinician has been confronted at one time or another with the large number of synonyms.
The master list, which we also have, includes:
a) primary keywords, about 150 000 words, and
b) a synonym list of about 600 000 words.

In order to operate the system the total field of medicine has been classified into 39 classifications plus 12 internal sub-divisions. Literature data received by us are incorporated in this very system.

## Automated documentation systems

In order to develop a computer orientated documentation system, as it was demanded by us, one would need 5 to 8 man years.
After carefully studying the possible programs at this time, in 1970, it was decided to use the Document Processing System (DPS) from IBM.
This program had, however, two disadvantages, especially in view of our project involving the storage of data material (approximately 1.7 mio documents). This we had to solve first:
1. restrictions for
   the number and size of the documents to be stored,
   the size of the bibliographic parts of a document,
   the number of the non-significant words.
2. On-line terminal dialogue was not possible.

These limitations of the program were solved within one and a half years, and the system is now running since 1971. In the meantime, IBM has introduced their new Storage and Information Retrieval System (STAIRS). This new program no longer contains the restrictions and limitations we faced with DPS. STAIRS allows on-line dialogue, furthermore a flexible dialogue, multiple data bases, and a variety of new functions, especially the functions BROWSE, RANK, SEARCH, SELECT.

In order to work with the DPS we had to use various program complexes for our software:
   programs for storage procedures into the storage with direct access,
   programs for search and retrieval of stored documents,
   programs for changes and reorganization (delete functions, additions or changes of documents),
   programs for the output of retrieval results and general information about the stored data (f.e. dictionnaire, synonym list, word frequency, etc.),
   program for the control unit and the data transfer from the data station to the terminal and reverse.

## Search procedures

Before turning to the search procedures it should be mentioned what type of information can be taken from the at present 1.8 mio documents since the year 1970 stored in our disc storage. The so-called formated part contains:
1. number of document
2. up to 4 authors
3. institution or address
4. title in English
5. title in the original language
6. periodical
7. year of publication
8. bibliographical data
9. language of original
10. country of original
11. classifications
12. tertiary terms, a) in code form,
    b) in clear language
13. Coden-Code of periodical
14. classification codes
15. primary terms, a) in code form,
    b) in clear language
16. secondary terms including trade marks and names of firms, with country of origin
17. abstract
18. subsequently we shall add the Wiswesser Line Notation for chemical formulae and for dialogue traffic.

Up to the secondary terms or point 16 runs the so-called formated part, and from point 17 the so-called non-formated part.

The search procedure is according to Boolean logic. In addition we have word extensions responding simultaneously to indexing terms with different endings (truncation).

Limitations may supply the position of a number of descriptor terms connected by "AND", i.e. the distance between words within the sentence or paragraph. Additional limitations can enable the additional requirement to be made, that the document found should contain certain data in the categories as mentioned before, f.e. certain authors, languages etc.

Besides the "AND" linkage (in order to narrow the search) certain conditions can be demanded, f.e. that the index words connected by "AND" do not appear only in the same document, but also within the document in a certain context. Or the word should appear in the same paragraph, or in the same sentence or within one sentence with a predefined distance from certain words. We can therefore search for the word rheumatic and fever and demand that the word fever should appear right after the word rheumatic, symbolized by (+1).

We can also enlarge the indexing words or word routes. F.e. the word "rheumatism" can be searched for by a truncation (S). This would mean that all entrances in our dictionary for the word rheuma would be shown on the terminal screen and we would then receive all variations of the truncated word "rheuma", such as: rheumatic, rheumatica, rheumatism etc. We can then introduce any of the new found words into the search in order to find the proper expression.
In addition, our documentation system offers the possibility of the use of synonyma, we designate these by (S). The statement RHEUMATIC-FEVER (S)
would mean that also the synonyma
acute articular rheumatism,
Bouilland disease,
polyarthritis rheumatica acuta,
rheumatic polyarthritis
would be automatically included into the search.

## Comparative operands

Up to now we dealt with index words only, that means elements of the automated contents analysis of a document, which have been stored in the dictionary. Additionally, we can demand that a document of a certain publication year or a certain paper should be found. This means that we will recieve relevant information only.
Since the comparative operands are sequentially stored and therefore belong to the formated part, it is better to start a search first in the text, that means in direct access, which would allow us to search a smaller amount of data sequentially afterwards.

## Statistics

If required, the system shows the frequency with which individual indexing terms occur in the stored material or the number of documents in the context research in which they appear. This also applies to logical configurations between index terms, and is a very useful aid, showing the frequency or rarity of indexing words in the occurance and frequency of logical linkages between words. Error reports show, when indexing terms are not included in the data base or have been incorrectly introduced. Formal errors, such as invalid logic configurations, are as well reported.

## Description of hardware

The data station, the visual display unit, IBM 2770, is installed via a normal telephone connection with the EDP-department, which is within a three miles distance, to the IBM/370-155 with 1.5 mio bytes. In the very near future we will have instead of the terminal IBM 2770, 14 terminals of IBM 3270 type connected with the IBM/370-158. The transfer of data between our terminal and the computer or vice versa is conducted with 4 800 bit/sec (approximately 600 signs/sec).
The program system DPS uses, inclusive the information job control program, about 150 K (during storage up to 200 K, the new STAIRS about 256 K) for one search. At present there are 18 magnetic discs IBM 3330 with a capacity of 1.8 mega bytes with documents; from these, 16 discs in the IBM 3330 are permanently for search purposes in direct access. By the end of 1974, two IBM 3333 with 3.2 mega bytes will be available in order to avoid disc changing. The response time of the system for one single query depends more or less on the number of stored documents and also from the search logic used. The average response time is between 2 and 20 sec. Only in a few cases one minute is exceeded. The actual CPU time is much shorter. At present, we have in our data centre an IBM printer 1403 and at the terminal site an IBM printer 2203, which prints 60 lines of a document in about 60 seconds.

## Search procedures

Search procedures are routinely done via the terminal (a visual display unit with keyboard), and secondly via punchcards which are directly fed to the main computing system.

## Process of searches

Incoming inquiries (mail, telephone, personally, etc.) are first run through the administrative system for statistical and accounting purposes. Furthermore, priority processing is decided. After this, the queries are distributed to our various specialists, such as pharmacists, medical doctors, chemists, etc. and the formulation of the search as well as the search strategy is decided.
A search can be supported by various search-words:

1. Thesaurus
   descriptor list,
   classification list,
   application code list,
   country code list,
   companies code list,
   Wiswesser Line notation code list,

2. Synonym list.
Via the visual display unit one can naturally also obtain statistical data as to how often the relevant search words are mentioned in the data base.
In formulating a search, the search words are entered, in local traffic, via the keyboard into the terminal in order to make a correction or receive a protocol print.
After examination, the search is transmitted to the computer. As soon as the reply is received at the visual display unit one can leaf through the various single documents and decide if the offered document qualifies for the search words put in. The dialogue with the data base is continued till the most relevant documents are found.
The procured documents can naturally be printed, small amounts of them right at the terminal, if more documents qualify (more than 200), this will be done via the fast printer IBM 1403 at the computer centre.

## Possibilities and use of the biomedical data system

### Ad-hoc-inquiries

The most important target in processing inquiries are the ad-hoc-inquiries which are forwarded to our data centre from all various sources. Ad-hoc-inquiries need about 2 to 3 days, due to the fact that we are at present working with the DPS program and by the end of August 1974 we shall be able to work with 14 terminals throughout Europe with the already explained new STAIRS system and the new IBM/370-158 and 2 IBM 3333 disc-storages, with a capacity of 3.6 mega bytes.

### SDI

SDIs can easily be maintained and are sent regularly to our customers. Most of the SDIs are done in intervals of three to six months.

### Sources

The system and the sources of information as already described naturally give further access to a documentation on drugs and substances, f.e.:

chemical name,
generic name,
test code / name or number,
manufacturer,
indications,
pharmacological data,
toxicological data,
side-effects,
composition,
formulae (Wiswesser),
summation formulae,
physical data,
title in English,
title in German,
authors,
institute,
bibliographical data.

As already mentioned, at present Excerpta Medica and Derwent-Ringdoc are being used. Being additionally prepared are the International Pharmaceutical Abstracts from the American Hospital Pharmacists Association as well as a tape-service about drug interactions and adverse drug reactions. Furthermore, it is planned to include via the program an environmental health documentation containing chemical substances and their different origins, especially plastic materials, dye stuffs, paints, lacquers, soaps, oils, fats, waxes, fibres, fire retardants, pesticides, etc.

The question may now arise why for such an extensive documentation scheme not MEDLARS but EXCERPTA MEDICA material has been used? Due to the fact that MEDLARS is already installed in the United States and Europe, a comparison between MEDLARS and EXCERPTA MEDICA revealed that MEDLARS concentrates more on compactness in the searches and in its answers, and does not offer the same excellent access possibilities as the EXCERPTA material for a terminal orientated on-line retrieval system. It had been found that the EXCERPTA material is far more thoroughly indexed and the polyhierarchical link categories cover the entire medical literature. This fact, and the addition of a very good retrieval program, make the EXCERPTA MEDICA material far more easily accessible. The biomedical information retrieval system, as it is functioning today, is already covering more than 300 ad-hoc-searches per month besides SDIs. The fact that quite a numerous amount of terminals will be connected with the system by the middle of this year, indicates clearly that the new STAIRS program, along with an enlarged disc storage, has been the correct way in achieving a safe and successful information service.

## International use and application

International scientists have long been concerned with the problem of international information retrieval systems, and attempts have been made in several places to organize the system of storage that would permit the easy identification, and rapid access and retrieval of data, usually with mechanical assistance. Due to the fact that terminal-oriented storage and on-line information retrieval systems are available nowadays and have already proved successful, it would be a desirable fact to have within certain geographical areas, such as the United States, Central America, or Europe etc. regional or national biomedical information centres. Information retrieval systems have been made possible by data-processing techniques originating in industry and commerce. Theoretically, any appropriate data-sorting equipment can be used, but in practice, when the information requirement is large and complex, the choice invariably falls to a computer as the main tool. As already mentioned, such systems are available nowadays and have been extensively discussed. Retrieval on-line dialogue programs, which offer the user a variety of resources for data base creation and maintenance, data base searching and document output, are also available to a satisfactory extent. Information can be retrieved from documents that contain unformated textual and/or formated data. Communication terminals permit the user to interact with the computer, that is, to compose his query in successive steps, using extended Boolean logic and/or by means of comparison operators. Such programs are for users in areas such as the biomedical information literature, where specific information must be immediately obtained from out of a large volume of documents. Furthermore, the retrieval programs should provide a highly flexible dialogue in which previous queries can be extended or referred to. Query formulations should be safe for later or current use, which gives the system a current awareness profile capability. Documents displayed should be paged backwards and forwards. Search and display should be restricted to a subset of paragraphs of the documents, and items found should be printed by high-speed printers.

The installation of such geographical main systems is nowadays possible at not too large costs and the possibility of national or regional input and output should, for all participants, be a most helpful device.
Such a terminal network should naturally be compatible with similar computer-orientated networks of other international institutions. The connection to an environmental control network is certainly within limits.

A further advance to obtain originals of any abstracted papers is certainly the microfilm and the microfiche. It is here thought to have regionally available on microfiche the original print of the abstract in the EDP storages. The system should be internationally compatible and controlled so that each document of the computer storage would correspond with the document number on the microfiche, thus giving fast and easy access to the original papers. Various commercial systems are available, and a commission should be set up to organize such systems with a worldwide base in order to have medical literature, medical terminology and medical knowledge combined in easy accessible systems.

Documentation and especially biomedical documentation are not any more a domain of the conventional documentalist. We have to depart from quite a number of 'good old customs'. Documentation has become one of the outstanding branches of a new developing science: the science of information.

# FEDERAL INFORMATION SYSTEMS

by

FRED S. DYER
Scientific and Technical Information Officer
Rome Air Development Center
Griffiss Air Force Base, New York, U.S.A.

## SUMMARY

The hub of the Federal Technical Information System is the National Technical Information Service under the U.S. Department of Commerce and is located in Springfield, Virginia. NTIS is the federal coordinator and distributor of U.S. Government sponsored research and analytical reports to the general public. Inputting or participating with this repository are a number of other Government repositories that are responsible for performing functions parallel to NTIS for the communities they serve and in some cases they also manage the classified/limited portions of their respective collections. These other repositories are found in the National Aeronautics and Space Administration (NASA), National Security Agency (NSA), Department of Defense (DOD), the United States Atomic Energy Commission (AEC) and the Government Printing Office (GPO). Information Analysis Centers (IAC's) and software services such as provided by the "COSMIC" service of the University of Georgia, supported by NASA, AEC and DOD also will be considered. A further extension that I will not cover directly is that of the Library of Congress, National Library of Medicine, National Agriculture Library and the many activities of Health, Education and Welfare, even though some of their products are to be found in or announced by the repositories of discussion.

Since from an external U.S. point of view most DOD repositories other than NTIS will be special cases, often unaccessible in the direct sense, and reachable only through NTIS; the emphasis will be on NTIS. I have found that since passage of the Freedom of Information Act, and the resultant pressures to force more information into the public domain through NTIS, that the dark side of these other repositories decrease in importance. At least this is a personal observation drawn from extensive DOD contacts.

I will review charters; customers; collection sizes; sources, if appropriate; entry methods; search and announcement services; products; costs and method of payment; and dwell on foreign retrieval aspects of the system.

## GOVERNMENT PRINTING OFFICE

I stated previously that NTIS is the hub of the U.S. Government Technical Information Service. Actually, the granddaddy of our system is the GPO which is the publishing and printing arm of the Federal Government. It was created by a joint resolution of Congress on June 23, 1860, and opened for business on March 4, 1861. From simple beginnings, the GPO has grown to an organization with annual expenditures exceeding $30 million and a staff of some 7,800 employees.

According to its official statement of purpose, the Government Printing Office 'executes orders for printing and binding placed by Congress and the departments....and agencies of the Federal Government; furnishes, on order blank paper, inks, and similar supplies to all governmental activities; distributes Government publications as required by law, and maintains necessary catalogs and a library of these publications; prints, for sale to the public, such documents as are not of a confidential nature." The chief administrative officer is the Public Printer, who is appointed by the President with the consent of the Senate. The Congressional Joint Committee on Printing supervises the operation of the office and serves as its board of directors.

The GPO Public Documents Department sells through mail orders and Government bookstores over 27,000 different publications which originated in various Government agencies. Administers the depository library program through which selected Government publications are made available in libraries throughout the country. A special brochure "How to Keep in Touch with U.S. Government Publications" is available by writing to the Superintendent of Documents, Washington, DC, 20402. The GPO releases a listing of "Selected U.S. Government Publications" which may prove of interest to you. Prices for listed publications are quite often under a dollar. A deposit account is available which helps overcome the problem of currency exchange.[1]

## NATIONAL TECHNICAL INFORMATION SERVICE

Returning to NTIS, the old office of Technical Service (OTS) of the Department of Commerce was re-designated "Clearinghouse for Federal Scientific and Technical Information" after Congress directed the Secretary of Commerce to establish and maintain "a Clearinghouse for the collection and dissemination of scientific, technical, and engineering information" by Public Law 776. The name was later changed to the National Technical Information Service.

The National Technical Information Service's charter presently names the facility as a central source for the public sale of Government sponsored research, development and engineering reports and other analyses. NTIS brings this information together from hundreds of federal sources such as the Department of Transportation, the Environmental Protection Agency, DOD, Housing and Urban Development, Health Education and Welfare, and NASA, including their contractors and grantees. Also, it is a central source for Federally-generated, machine-processable data files and programs.

NTIS fills 5,000 new and 6,000 standing orders daily as one of the world's leading processors of specialty information. It supplies the public with approximately three million documents and microforms annually. The NTIS information collection exceeds 730,000 titles. More than 100,000 documents are in current stock. All are available for sale to the public in paper copy and/or microform. Since the agency is obligated by statute to recover its costs, products are appropriately priced. Less than 20% of its funding comes from its direct appropriation as an agency of the U.S. Department of Commerce. In addition to announcement media, which will be described shortly, an annual catalog is prepared for the reports most in demand.

The public may quickly locate abstracts of interest among 500,000 federally-sponsored research documents and among 85-100,000 ongoing research projects, using the agency's on-line computer based custom bibliographic search service NTISearch. The NTISearch information collection covers all federally sponsored research projects completed since 1964. And, you can be sure the collection is kept up-to-date with the latest research findings. Each day, more than 200 new research reports are added.

Through NTISearch, you can assess the great breadth of technical innovations being developed by researchers working on government-sponsored projects.

The system is automated but flexible, fast but accurate. The entire collection is combed to find the specific information you need.

NTIS has a special search request form that can be used or you can telephone (703) 451-0560 to start the search. I have found that direct contact with the search analyst is the best method if possible since it gives an opportunity to assure both parties that the search question is understood and the results less apt to be skewed.

To develop your search question, simply describe the subject you wish explored. Define any terms that have special meaning. Please give points not to be included, and say what you want to use the information for.

Smithsonian Science Information Exchange's (SSIE) current research information file is also available through this one point of contact, NTISearch. This gives access to on-going research project information along with the completed research reports.

The SSIE file of on-going research projects includes who supports each project, who does the work, where and when the research is performed and a technical summary. It covers basic and applied research in life, physical, social, behavioral and engineering sciences.

If ordered separately, the two searches would cost $50 each; $100 for both. The NTISearch combination fee for both the NTIS file of completed research reports and the SSIE file of on-going research project information is $85 for the first 125 Abstracts and 25 cents for each abstract thereafter. You can also select from a large number of searches already completed and benefit from the initiative of other search users at the low package price of $20 a search. Select from categories which include chemistry, physics, environmental management, construction, the food industry, biological science and management techniques.

Current abstracts of NTIS documents and other records in various categories of interest are published in weekly journals (Weekly Government Abstracts). An all-inclusive semi-monthly journal, Government Reports Announcements (GRA) is published and magnetic tapes from which all the journals are prepared are also available.

A microfiche service, with a custom-profile option, automatically provides subscribers with the full texts of reports in categories of interest they select.

Abstracts of Government research are published semi-monthly in one volume. Coverage is comprehensive - 60,000 abstracts a year. The GRA format was designed specially for librarians and technical information specialists and those familiar with technical reference terms.

GRA features a quick-scan format (includes title, price and corporate author), edge index to subject fields and report number locator list. The whole texts of most documents abstracted in GRA may be ordered directly from NTIS in paper copy or inexpensive microfiche.

Some abstracts published in the WGA newsletters, such as Government owned patents available for licensing, and reports of the Earth Resources Technology Satellite are not published in GRA.

GRA categories are: Aeronautics; Agriculture; Astronomy and Astrophysics; Atmospheric Science; Behavioral and Social Sciences; Biological and Medical Sciences; Chemistry; Earth Sciences and Oceanography; Electronics and Electrical Engineering; Energy Conversion (non-propulsive); Materials; Mathematical Sciences; Mechanical, Industrial, Civil and Marine Engineering; Methods and Equipment; Military Sciences; Missile Technology; Navigation, Communications, Detection, and Countermeasures; Nuclear Science and Technology; Ordnance; Physics; Propulsion and Fuels; Space Technology, Environmental Support Statements.

Government Reports Index is published concurrent with GRA and indexes the GRA abstracts by subject, personal and corporate authors, and by Government contract and order numbers.

Annual subscription for each separately, GRA $52.50, GRI $57.50, foreign $67.50; combined GRA/GRI is $97.50, foreign $125. The magnetic tape from which GRI and GRA are prepared is available for lease.

Annual Index Volumes for 1972 are also available by; Subject, Personal Author, Corporate Author, Contract Numbers & Partial Accession/Report Numbers, Continuation of Accession/Report Numbers. Only sold as a six-volume set. $250. Foreign $325.

The new Weekly Government Abstracts (WGA) newsletters are more frequent and improved successors to the semi-monthly "Government Report Topical Announcements (GRTA), and will be found of great benefit for following one to several categories of interest. Abstracts of reports are published two weeks after receipt by NTIS. Only WGA's contain NASA abstracts and Highlighted-Annotated special interest citations.

The number of WGA titles gradually replacing GRTA titles will be flexible, changing in accord with subscribers' requirements. Twelve titles have been converted from the GRTA series and are available for annual subscription. They are (domestic price first, foreign second):

| | |
|---|---|
| Administration | $17.50/22.00 |
| Behavior | 35.00/43.75 |
| Biomedical Technology & Engineering | 28.00/35.00 |
| Building Technology | 17.50/22.00 |
| Business & Economics | 28.00/35.00 |
| Computer, Control & Information Theory | 22.50/28.25 |
| Environmental Pollution & Control | 22.50/28.25 |
| Industrial Engineering | 35.00/43.75 |
| Library & Information Sciences | 20.00/25.00 |
| Materials Sciences | 22.50/28.25 |
| Transportation | 17.50/22.00 |
| Urban Technology | 35.00/43.75. |

Subject areas covered under the foregoing titles are available on request.

Many regular NTIS customers have found it helpful to receive newsletters in more than one area of interest. Therefore, a discount of $3 is allowed for each additional title when two or more are ordered on one form.

The most selective and inexpensive way to quickly obtain the complete texts of the latest reports is called SCIM (Selected Categories in Microfiche). Automatic distribution of newly released information is only in the subject areas you select.

Subscribers to SCIM may order all documents announced in any subject category, both prime and cross-referenced documents; or only the prime documents, eliminating cross references. Subscribers to more than one category do not receive duplicate texts. You receive the complete document (on microfiche) rather than just the abstracts as listed in WGA.

Order by agency (Dept of Defense, NASA, AEC, Commerce) or by subject area.

Semi-monthly standing orders distribution. 45¢ a title; foreign 60¢. (Usual single microfiche price, $1.45; foreign $2.95). SCIM service requires a Deposit Account.

SCIM/PROFILE is a continuous custom service to provide subscribers with only those microfiche identified by specific descriptors which compose individual customer profiles.

Your interest profile is a composite of the descriptors you choose. It will be matched by the computer with all other information in the data base to select the microfiche you should see.

Microfiche selection is continuous and direct, eliminating bothersome notification procedures. The price of the new service is tailored to your requirements.

HOW TO ORDER FROM NTIS:

Material and services may be obtained by several methods. NTIS has standard order forms covering the various areas and in addition you can contact them directly by telephone (703) 321-8000, Telecopiers use phone (703) 321-8547 and Telex service 89-9405.

Return the order forms to NTIS, 5285 Port Royal Road, Springfield, VA 22151.

When ordering specify the report or order numbers and the complete titles of the documents. Specify a particular category or field of interest where there is a selection to be made.

Payments may be by check, money order, or by charging an NTIS deposit account. You may open an account with a deposit of $25 and draw on it with your first order. Thereafter, no minimum balance is required and there is no service charge. But a positive balance must generally be maintained. You will receive pre-addressed order cards or forms which will speed your order, minimize accounting and record keeping, and help keep track of tax deductible expenses.

All foreign orders must be accompanied by NTIS deposit account order cards or forms or a check drawn on a U.S. bank. International money orders and traveler's checks convertible to U.S. currency also are accepted. The Ship and Bill service is not available to foreign customers.

When ordering with a check, give your bank copies of your order or instructions with a request that a check be made payable to the National Technical Information Service.

Two copies of your order should accompany your bank's request to a U.S. bank. The U.S. bank will forward one copy of your order with its check to NTIS.

Wherever a foreign sales price for individual documents is NOT specified in the listings, all foreign buyers must add: $2.50 for each document; $1.50 for each microfiche.

NOTE: Scandanavian Users: Forward all NTIS requests to: Mrs. G. Sundgren, Scandanavian Documentation Center, 1225 19th St., N.W., Suite 502, Washington D.C. 20036.[2,3]

## DEFENSE DOCUMENTATION CENTER

The Defense Documentation Center (DDC), a field activity of the Defense Supply Agency of the Department of Defense, makes available from one central depository thousands of research and development reports produced each year by U.S. military organizations and their contractors. The Center also operates computer-based banks of management and technical information concerning current R&D projects, and is responsible for development of improved information and retrieval systems.

Prior to March 1963, DDC was known as the Armed Services Technical Information Agency (ASTIA) and was under the operational control of the Air Force. ASTIA was formed in 1951 by consolidating the missions of the two documentation centers then serving the Department of Defense - the Navy Research Section in the Library of Congress, Washington, D.C. (operated by the Office of Naval Research), and the Central Air Documents Office at Dayton, Ohio (operated by the Air Force). In 1958, the two document centers were physically combined and moved to Arlington, Virginia. In March 1963, the name of the agency was changed from ASTIA to the Defense Documentation Center, and in July 1963, the Center was moved from Arlington, Virginia to the present location at Cameron Station, Alexandria, Virginia. On November 1, 1963, operational control of DDC was transferred from the Air Force to the Defense Supply Agency.

The Center is under the policy direction of the Office of the Director of Defense Research and Engineering, Department of Defense. Representatives of the three military departments and other interested Defense activities provide assistance and advice to the DDC Administrator on joint operational policies and procedures.

Defense facilities and their contractors are required to submit to DDC copies of each report (up to and including Secret and Restricted Data) that formally records scientific and technical results of Defense-sponsored Research, Development, Test & Evaluation. The documents are screened at DDC to ensure they are of scientific and technical scope and to make certain that they are not duplicates of reports already in the collection. Upon selection, each report is assigned an AD (Accession Document) number, processed into the collection, and recorded by microphotography.

The Center's technical report collection currently totals more than a million titles. Those accessioned since March 1953, about 670,000, are under computer control for quick retrieval. These include more than 65,000 titles in the field of electronics and electrical engineering and 90,000 which concern studies in physics. Almost all areas of science and technology are included.

DDC announces the existence and availability of accessioned documents through its own announcement publication and through announcement media of NTIS.

For announcement, the technical reports are categorized in a two-level arrangement consisting of 22 major subject fields, with a further sub-division of fields into 188 subject groups. This is an extension of the subject categories developed through the Committee on Scientific and Technical Information (COSATI) of the Federal Council on Science and Technology and is the equivalent of the NTIS categories.

Classified reports and unclassified reports having distribution limitations are announced in the Confidential DDC Technical Abstract Bulletin (TAB) twice a month. Announcements of unclassified reports having no distribution limitations are listed with similar reports produced by other Federal agencies in the GRA.

Companion index volumes (TAB Indexes and Government Reports Index) are available for each issue of the aforementioned announcement publications to aid the user in determining quickly which, if any, new accessions in the collection are of particular interest. Each of these reference tools includes a Corporate Author-Monitoring Agency Index, Subject Index, Personal Author Index, Contract Number Index and a Report Number (or correlation) Index. In addition, TAB indexes include a Title Index and a Release Authority Index. The indexes are cumulated quarterly and annually. The Annual Indexes to TAB are available in full-size or microfiche.

Although originally created to serve the military, DDC services have been extended to all Federal Government agencies and to their contractors, sub-contractors and grantees. In addition, research and development organizations, without current contracts, may be declared eligible for documentation services by a military service under the Defense Potential Contractors Program.

DDC does not serve the general public directly, but every effort is made to give the scientific and industrial community access to reports having no security or other distribution restrictions. Such reports are sent to NTIS. Unclassified reports, announced and sold by NTIS, are subject to that agency's pricing policies.

To assist organizations in registering for service, DDC provides a manual entitled, "Registration for Department of Defense Scientific and Technical Information Services," DSAM 4185.3. The manual outlines registration procedures and includes a complete sample of pertinent DOD Forms.

Upon registering with DDC, an organization is sent a service package containing the necessary instructions and forms for requesting documents and other services. The organization also is placed on the distribution list to receive the DDC Digest, a publication designed to keep user organizations informed of changes in the Center's policies, services and products.

Registration for DDC services also assists the user in obtaining access to services offered by Defense-sponsored Information Analysis Centers and by major DOD technical libraries. The Center maintains a central authority file of users having established their eligibility for access to Defense scientific and technical information. The levels of clearance for classified information and the need-to-know categories by subject areas are maintained in this file.

Requesting Reports: Organizations registered for DDC services may request copies of the technical reports in either full-size or microform. The Center assesses a $3 service charge for full-size copies of technical reports; the charge for copies in microform is $1.45 per document. Requests for documents are submitted to NTIS who handles the financial transactions for DDC.

Authority to provide a document is governed by its security classification, any release limitations imposed by the source of the report, and by the requestor's need-to-know. Special provisions for requesting copies of documents having limitations on their distribution include review and approval of release by the responsible source in all cases where required.

You, as a requestor presumably not affiliated with the U.S. Dept of Defense can access documents under cognizance of DDC but not directly. Contacts are made for respective countries as follows and, of course, would only be in connection with bonified Government activities:

Canada:
Miss M. Marriott
Canadian Defense Research Staff
2450 Mass. Ave., N.W.
Wash. D.C. 20008

Norway:
Lt. Col. Bjarne S. Assberg
Norwegian Military Mission
2720 34th St., N.W.
Wash. D.C. 20008

Italy:
Commander Antonio Barile
Office of the Naval Attache
Italian Embassy
2110 Leroy Place, N.W.
Wash. D.C. 20008.

Other contacts:
Aviation Attache: Captain Raoul Restucci
Military Attache: Mr. Antonio Buttaro
Naval Attache: Lt. Commander Cazzuline.[4,5]

## FREEDOM OF INFORMATION

Breaks came for foreign users of our U.S. Government System and our general public in the form of the Freedom of Information Act PL 89-487, covered in Section 552, title 5 U.S.C., and Executive Order 11652 covering classified information. What was sought was improved administrative operation of Government Agencies and to make them more responsive to the general public. This is covered by Section 571, title 5 U.S.C.. The Act became effective 4 July 1967. Congress, in adopting the Act, adopted a policy that any "person" should have clear access to identifiable agency records without having to state a reason for wanting the information, and that the burden of proving withholding to be necessary is placed on the Federal Agency. This law was initiated by Congress and signed by the President with several key concerns:

That disclosure be the general rule, not the exception.
That all individuals have equal rights of access.
That the burden be on the Government to justify the withholding of a document - not on the person who requests it.
That individuals improperly denied access to documents, have a right to seek injunction relief in the courts, and
That there be a change in Government policy and attitude.

Under the law, withholding of information by the Government is permissive, not mandatory, and must be justified under one of the 9 exceptions. Consequently, most of the limited distribution material held by the Defense Documentation Center has been re-assessed for public release and a quantity of material forwarded to NTIS. Also, new procedures instituted by DOD Directive 5200.20 have contributed to this letting down of material to the public. Presently, the non-classified reasons for withholding such information are as follows:

a. It contains information from a foreign government and they request we do not release further.

b. Proprietary considerations.

c. Test and evaluation results of commercial products or military hardware which would be unfairly prejudical to the manufacturer of the product.

d. Contractor performance management reviews or other advisory documents evaluating contractor programs.

If a document is not classified, and does not meet any of the above criteria, it must be considered for public disclosure and placed in NTIS and thereby becomes readily available to you through public channels.[6,7]

## NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Since 1958 the National Aeronautics and Space has been discovering new things about materials, machinery, and human beings, as well as about the Earth, the Moon, and the Universe. Mankind's gain would be slight if these many discoveries were not widely shared. From the beginning, therefore, the information and data acquired have been collected and made available to prospective users both within and outside of the aerospace community.

This is the primary function of NASA's scientific and technical information system. It assembles the results of worldwide aerospace research and development activities. It summarizes, indexes, and stores this wealth of knowledge. It helps individual persons find and benefit from the particular parts of this great mass of technical literature that are most likely to help them solve their problems.

The NASA information bank now contains approximately 1,000,000 documents. Thousands more are added to it every month.

These government, industry, research institute, and university reports, journal articles, and reviews contain the details of findings of NASA personnel, contractors, sub-contractors, and grant-holders. Along with these items the information bank regularly receives new technical literature and specialized reports such as project records, patents, etc., from other U.S. Government agencies, laboratories and institutions supported by private industry, and other major sources of aerospace knowledge throughout the world.

Many significant items are received routinely from other countries in exchange for information from NASA; others are specifically requested for interested users of the NASA system.

NASA has pioneered in automating the storage, retrieval and dissemination of aerospace information and data.

The NASA Scientific and Technical Information Facility, in College Park MD., receives hundreds of documents daily. These are promptly checked to avoid duplication, examined for relevance, and cataloged descriptively. Each document accepted as a potentially valuable addition to this information bank is then given an accession number and, if appropriate, is recorded on microfiche. The accession number serves as a unique identification tag for the document thenceforth, a copy of every page can be made from the microform for distribution as needed. Distribution microfiche can be made from the microfiche master.

Professional indexers examine each item when it is deposited in the system, document the bibliographic data that accompanies it, and select terms under which it is listed in subject and other indexes.

Trained abstractors read the abstracts submitted with documents, sometimes edit and condense these summaries, and write abstracts of documents which have been received without them. Then, after further reviewing, complete bibliographic records are placed in the memory of a high-speed electronic computer. From then on, the machine provides ready access to the citations of all documents for all users.

From the day a document is acquired, it can be located quickly by its accession number. This number can be ascertained from other bibliographic information in the computer. A searcher need only know the corporate source, or the authorship, or the subject, or the number assigned to the document in another U.S. Government agency's information system, or the number of a contract under which the work was performed, to be directed to a report he needs.

The most widely used guides to the NASA scientific and technical information system's contents are two complementary abstract journals: "Scientific and Technical Aerospace Reports" (STAR), and "International Aerospace Abstracts" (IAA).

The abstracts in STAR cover worldwide report literature relative to space and aeronautics. The abstracts in IAA provide similar coverage of scientific and trade journals, books, and papers presented at meetings on aerospace research.

Both journals are issued twice a month. The Scientific and Technical Information Office of NASA's Office of Industry Affairs and Technology Utilization issues STAR on the 8th and 23rd days of each month. The Technical Information Service of American Institute of Aeronautics and Astronautics issues IAA under contract to NASA on the 1st and 15th days of each month.

Expert processing and speedy photocomposition assure up to date announcement by both journals. The abstracts in each one are intended not merely to suggest the subject matter, but to summarize the significant findings and innovations reported.

STAR and IAA are organized and indexed in basically identical ways.

The abstracts in each issue of STAR and IAA are grouped according to the subject matter. There are 34 categories and the scope of each category is explained in the Table of Contents of each issue.

A carefully structured indexing system further facilitates the use of each journal. A reader with a specific problem can find summaries of the documents most likely to help him without plowing through abstracts of many others.

Users of the NASA information bank also may learn of some additions to it in other ways, including bibliographies, other special publications and a current awareness service known as SCAN (Selected Current Aerospace Notices) which are now available to NASA contractors and grantees.

Anyone may subscribe to STAR and IAA. The annual subscription rate to STAR is \$76.50; IAA, \$160.00 within the U.S. and all other Western Hemisphere countries except Argentina, Brazil, French Guiana, Surinam, and British Honduras. Elsewhere it is \$95.65 for STAR and \$175.00 for IAA. Subscriptions to the cumulative indexes for STAR are \$25.55 for domestic subscribers and \$31.95 for foreign subscribers; for IAA \$100.00 for domestic subscribers and \$115.00 for foreign subscribers. Combined IAA rates are \$240.00 domestic and \$270.00 for foreign customers.

Subscriptions to STAR are filled by the Superintendent of Documents, U.S. Government Printing Office, Wash D.C., 20402 (from whom a single copy of STAR may be purchased for \$3.25 domestic and \$4.10 for foreign mailing. Subscriptions to IAA may be purchased from the American Institute of Aeronautics, Inc., 750 Third Ave., New York NY 10017.

There is no charge for STAR to NASA technical and administrative personnel; registered NASA contractors, subcontractors, grant-holders, and consultants; or to many universities and colleges, or many public and special libraries. Foreign organizations that have agreed to exchange scientific and technical information of value with NASA also may obtain STAR without charge.

NASA personnel receive STAR by submitting their requests through their technical libraries. Others eligible to receive STAR without charge should address their requests to the NASA Scientific and Technical Information Facility, P.O. Box 33, College Park, MD., 20740.

Every issue of each journal contains directions for obtaining copies of the documents abstracted in it. Microfiche of many documents is available free to many users of the system. Other persons consulting these journals can purchase microfiche from NTIS.[8]

## UNITED STATES ATOMIC ENERGY

Management of the scientific and technical information effort of USAEC is the responsibility of the AEC technical information center (TIC). The mission of TIC in the broadest sense is to arrange and assist in the transfer of scientific and technical information from multiple points or origin to multiple points of use without regard to the location of producer or user.

TIC functions on a national and international basis to acquire the literature of nuclear science and technology through bilateral agreements with foreign countries, special exchange programs or organization-to-organization agreements.

Approximately two-thirds of the international nuclear science literature is contained in some 3000 scientific journals; the remaining one-third is contained in research and development reports, conference proceedings, patents, books, monographs, thesis, and engineering drawings and related materials.

About 43 percent of the total volume of nuclear literature originates in the United States. About 43 percent originates in eight other countries (USSR, West Germany, U.K., France, Japan, Italy, Canada, and India). The remaining 14 percent comes from some 60 additional countries.

Literature generally is acquired by the following methods:

1. Routine distribution to TIC by AEC contractors and some U.S. government agencies.
2. Bilateral agreements with foreign nuclear energy establishments.
3. Publication exchanges initiated either by TIC or by the exchange partner.
4. Gifts (books and some journals and conference proceedings).
5. Direct purchases. (These are required for some journals and books, e.g., those published in the USSR. The U.S. Embassy in Moscow handles special purchases of books within the stated scope of AEC interests.)
6. Directly from technical societies, such as the American Institute for Physics.

The remaining items are procured for the most part on an individual request basis. TIC becomes aware of items of literature by scanning accession lists, bibliographies, other abstracting services, listings of meetings and conferences, etc. Many research and development reports are procured as a result of their being requested from TIC. If a requested report is not already on file, TIC procures it for the requestor and then evaluates it for the TIC data base.

Once received, all information is carefully evaluated and analyzed to determine its precise subject content. The portions selected as being within the AEC's scope of interest then become part of the AEC's science information archives. They are further announced, reproduced, distributed, indexed, and abstracted to provide the controls necessary for retrieval on both a current and a retrospective basis.

The objective of the TIC bibliographic activity is to announce promptly the existence and location of literature on nuclear energy and to provide discrete identification, abstracts, and indexes so that specific portions of the information can be retrieved on a retrospective basis. This objective is met principally through the semi-monthly publication of the abstract journal Nuclear Science Abstracts (NSA). The abstracts in NSA are divided into 22 main subject categories. This makes it possible for a user to concentrate on a specific subject area if he does not wish to scan everything.

Each issue of NSA carries four separate computer prepared indexes: subject, personal author, corporate author (issuing source), and report number. These indexes are cumulated periodically.

NSA is the only published document in the world which provides complete control over the vast amount of nuclear science literature. More than 720,000 items of literature have been abstracted and indexed in the 26 volumes of NSA published to date.

NSA is published primarily to serve the needs of the AEC and its contractors; however, it is publicaly available on a subscription basis from the Superintendent of Documents, U.S. Government Printing Office. Some 3000 copies are sold throughout the world, and another 3000 copies are distributed for official purposes. By using NSA any organization or individual can cope with the mass of nuclear science literature and can retrieve useful documents. Those who do not have access to computer retrieval still, with NSA, have a means for manual retrieval.

All printed AEC reports are made available for public sale through NTIS.

Documents not printed are available in microfiche through a contract with Microsurance, Inc.. Enlarged copy is also available. They sell directly to whoever they can including Government users.

Unit prices of microfiche are $0.1087 each when all microfiche are purchased; $0.1137 per fiche if selectively purchased by category; and $0.33 per microfiche if individually ordered (on demand). The annual cost to an organization purchasing all reports is estimated by the AEC to be about $2400 for about 22,000 microfiche required for 13,800 titles.

Enlarged copy from the original microfiche negative is provided at a cost of $.06 per page of original text. (Because of filming techniques, blank pages will in certain instances also be charged for at this rate).

Postage and sales tax (if applicable) will be a separate cost.

All financial arrangements should be made directly with Microsurance, Inc.. The company prefers a deposit account and will render monthly statements showing deposit account balances. However, for those customers who so prefer, Microsurance will make monthly billings for microfiche distributed or hardcopy ordered (with prior credit approval).

For the three countries of interest to this lecture series, collections of AEC reports are maintained by the following organizations:

| | |
|---|---|
| Canada: | Chalk River, Ontatio, Atomic Energy of Canada, Ltd.,<br>Chalk River Nuclear Labs<br>Ottawa, National Research Council<br>Vancouver, B.C., University of British Columbia Library |
| Italy: | Rome, Centre di Studi-Nucleari della Casaccia |
| Norway: | Kjeller, Institutt for Atomenergi.[9] |

## COMPUTER SOFTWARE MANAGEMENT INFORMATION CENTER (COSMIC)

COSMIC was established early in 1966 at the University of Georgia to collect and disseminate to the public, computer software developed by Government agencies. Since that time thousands of computer programs in all areas of aerospace, engineering, mathematics, business, and industry have been distributed to companies and industries throughout the United States.

COSMIC accepts programs from various government agencies particularly the National Aeronautics and Space Administration and the Department of Defense. General programs are also received from universities and other agencies.

The Technology Utilization and Office of NASA, designed to enlarge the return on the public investment in aeronautical and space activities, was the initial sponsoring agency to formally participate. The Department of Defense joined in the COSMIC endeavor later. With the joining of these two major agencies, the original concept of making tax paid developments available to the public also became that of acting as a transfer point between and within government agencies. Announcement is made by use of Computer Program Abstracts. Computer Program Abstracts is published quarterly for the National Aeronautics and Space Administration by Informatics TISCO, Inc., and is arranged in five sections. The first section contains program citations and abstracts arranged in thirty-four subject categories. Following are four indexes: subject, originating source, program number/accession number, and equipment requirements.

## AVAILABILITY OF COMPUTER PROGRAM ABSTRACTS

Computer Program Abstracts is available to the public on subscription or individual issues from the Superintendent of Documents, United States Government Printing Office, Washington, D.C., 20402. United States of America, at the following rates:

Annual subscription rate: $2.60 domestic (Add $0.65 for foreign mailing). Price per single copy: $0.65 effective 1 January 1974.

## AVAILABILITY OF COMPUTER PROGRAMS AND DOCUMENTATION

Computer programs and related documentation listed in Computer Program Abstracts can be ordered at prices indicated in the Abstract Section from the sources listed below. Prices are subject to change without notice. Prices include normal shipping charges: special shipping can be arranged at customer's expense. Ten dollars ($10.00) constitutes a minimum order. All orders should specify billing procedures and specific items desired: i.e., documentation only, program only, or both documentation and program. Programs are complete and operable unless otherwise noted in the Abstract Section.

Tapes normally supplied in 7 track - 556 bits per inch card image format. Other forms supplied by arrangement directly with COSMIC.

Computer programs and related documentation are available at prices indicated from:

Computer Software Management and Information Center
Barrow Hall
University of Georgia
Athens, Georgia 30601

In addition to the source indicated above, documentation for certain computer programs has been issued in the form of a NASA formal series report and is available from the National Technical Information Service, Springfield, Virginia 22151 at the price shown in the citation for hard copy and $1.45 for microfiche. This availability is indicated at the end of the specific program abstract in the Abstract Section.

Sales are normally limited to domestic United States purchasers only. Inquiries concerning availability outside the United States should be addressed to:

Director, Technology Utilization Office
Code KT
National Aeronautics and Space Administration
Washington, D.C. 20546.[10]

## INFORMATION ANALYSIS CENTERS (IAC's)

An information analysis center is a formally structured organizational unit specifically (but not necessarily exclusively) established for the purpose of acquiring, selecting, storing, retrieving, evaluating, analyzing, and synthesizing a body of information and/or data in a clearly defined specialized field or pertaining to a specific mission with the intent of compiling, digesting, repackaging, or otherwise organizing and presenting pertinent information and/or data in a form most authoriatative, timely, and useful to a society of peers and management.

In applying this definition to develop standards of reference for selecting the centers to be included as information analysis centers, the following criteria have been formulated:

The key activities are the analysis, interpretation, synthesis, evaluation, and repackaging of information for the purpose of enabling users better to assimilate the information or numerical data of a specific field.

An information analysis center produces new, evaluated information in the form of critical reviews, state-of-the-art monographs, or data compilations and usually provides substantive, evaluated responses to queries.

An information analysis center provides assistance to a community of users and not just assistance to "in-house" personnel.

Organizations usually referred to as IAC's are mainly concerned with the analysis and communication of highly specialized technologies - the very latest in the state of an art. Some, however, concentrate on the evaluation of cultural, educational and socio-economic data. The hundred or more federally sponsored IAC's in the U.S. are considered national resources of particular knowledge.

Usually IAC's define their operations within three principal categories.

Technical Inquiry Services: The custom searching of an information collection relevant to specific queries; combined by some IAC's with analytical research and evaluation.

Data Books & Research Reports: Often these are state-of-the-art reports; that is, the best information available on a subject. Also published in this category are annotated bibliographies, technical guides, and directories of terms and processes.

Current Awareness Bulletins: These reflect the latest technical achievements, in brief, as they are observed and recorded for subsequent detailed evaluation; usually available on a subscription basis.

Access to most IAC's is outlined in "Directory of Federally Supported Information Analysis Centers" COSATI-70-1, PB 189300 available from NTIS.

NTIS is the national marketing coordinator for various IAC's sponsored and partially financed by the Department of Defense, the Atomic Energy Commission and the Department of Commerce, all of which have been required to make products and services available to the public. Making the resources of these centers available to industry is intended to generate additional public applications from the original Federal fundings. The following IAC's products and services would be available directly to you through use of your NTIS deposit account.

CHEMICAL PROPULSION INFORMATION AGENCY
CRYOGENIC DATA CENTER
EXPLOSIVES LABORATORY, FELTMAN RESEARCH LABORATORIES
INFRARED INFORMATION ANALYSIS CENTER
MACHINABILITY DATA CENTER
MECHANICAL PROPERTIES DATA CENTER
METALS AND CERAMICS INFORMATION CENTER
NUCLEAR SAFETY INFORMATION CENTER
PLASTICS TECHNICAL EVALUATION CENTER
RELIABILITY ANALYSIS CENTER
THERMOPHYSICAL PROPERTIES RESEARCH CENTER
TOXICOLOGY INFORMATION RESPONSE CENTER.[11]

It is realized that there is another whole side of this information picture centered about the Library of Congress. This was deliberately avoided because of the scope, size and intricity of this segment and perhaps will be covered in a later Lecture series. I felt when structuring my portrayal of the Federal Information System that my audience would be most interested in the repositories described

In conclusion, I've tried to briefly outline not only the scope of the Federal information activities of the United States, but how anyone including foreign users can make use of their many products and services.

References

1. United States Government Organization Manual. 1972-1973. Government Printing Office.

2. NTIS Information Services, May 1973.

3. Searching the NTIS Files - Problems and Opportunities (unpublished), Ms. Mary Jane Ruhl.

4. Defense Documentation Center, Its Programs & Services.

5. Diplomatic List, February 1973. U.S. Government Printing Office.

6. Minutes; STINFO Officers Meeting, 14-15 August 1973.

7. Department of Defense Directive Number 5200.20; Subj: Distribution Statements (Other Than Security) on Technical Documents.

8. The NASA Scientific and Technical Information System --- And How to Use It.

9. AEC Technical Information Center -- Its Functions and Services, October 1972; United States Atomic Energy Commission Technical Information Center, Oak Ridge, Tennessee.

10. COSMIC, The University of Georgia.

11. Directory of Federally Supported Information Analysis Centers; Committee on Scientific and Technical Information Panel on Information Analysis Centers, January 1970, PB 189300.

# THE NASA REGIONAL DISSEMINATION CENTER

by
Edmond Howie
Associate Director
Knowledge Availability Systems Center
University of Pittsburgh
320 L.I.S. Building, 135 N. Bellefield
Pittsburgh, Pennsylvania 15260

## SUMMARY

An overview is presented of the Knowledge Availability Systems Center and its role as a National Aeronautics and Space Administration Regional Dissemination Center. Particular emphasis is placed on the marketing, technical analysis, technical operations and engineering consultation functions of the Center as they relate to user exploitation of its mechanized information resources.

My responsibility to you today is to describe how the Knowledge Availability Systems Center (hereafter referred to as the KAS Center or KASC) operates as a National Aeronautics and Space Administration Regional Dissemination Center (RDC) providing mechanized information retrieval services--on a fee basis--to both academic and non-academic patrons. In this capacity--that of an RDC--the primary mission of the KAS Center is that of transferring technology. The provision of mechanized information retrieval services is a means to that end.

When Congress passed the United States Space Act of 1958, it included in the law a requirement to make available to the non-aerospace sector of the economy--as practicable--the scientific and technical knowledge generated and marshalled for application towards the primary mission of the space program--the peaceful exploration of space. Today, I am going to recount to you one aspect of NASA's efforts to make available to our society the vast amount of mission oriented information acquired, generated and documented by the National Aeronautics and Space Administration.

The information problem which faced NASA was two-fold. First and foremost was the problem of creating an instrument to gather, organize and control any and all available documented knowledge which could be used by our space team: not only that information which existed but also that which would be generated during the space program.

Second was the problem of creating a mechanism for disseminating this information throughout the space family itself--a mechanism which would minimize duplication of effort, which would permit its own scientists and engineers to benefit from each others experience--and which would permit (as practicable) the dissemination of this same information to the non-aerospace sector of the economy.

Two NASA organizational entities were assigned these responsibilities. First: the Scientific and Technical Information Division (STID) was given the task of gathering, organizing and converting all available and relevant information into machine-readable form. Second: the office of Technology Utilization was assigned the task of disseminating this information to the public.

STID developed what we refer to as the NASA file. This file is bibliographic in form, contains over 800,000 items, and is growing at a rate of 4,000 - 6,000 new accessions each month. The information in the file is of two types: one type is unpublished literature not normally available to the public (i.e., progress reports on contracted efforts by such organizations as General Electric, RCA, Lockheed, and Westinghouse). The other type consists of published literature such as articles appearing in scientific and technical journals or proceedings of professional societies which are available to the public and through which you normally browse in your libraries.

The entire NASA file is available in published form in two abstract journals. The N-type document abstracts appear in the Scientific and Technical Aerospace Journal (STAR), published by the Government. The A-type document abstracts appear in the International Aerospace Abstracts journal (IAA), published under contract to NASA by the American Institute of Aeronautics and Astronautics.

Thus, our NASA file is basically STAR and IAA on magnetic tape. The entire file contains approximately 50% N-documents and 50% A-documents. The origin of the items announced in STAR, in percentages are:

| | |
|---|---|
| NASA and Contractors | 21% |
| DOD and Contractors | 30% |
| Other Government Agencies and Contractors | 6% |
| Other U.S. | 12% |
| U.S.S.R. and Soviet Block | 19% |
| Other Foreign | 12% |

The origin of items announced in IAA, in percentages, are:

| | |
|---|---|
| U.S. | 56% |
| U.S.S.R. | 15% |
| Britain | 11% |
| France | 3% |
| Germany | 3% |
| Other Foreign | 12% |

Thus far I have been describing to you the NASA file, a linear, bibliographic file on magnetic tape currently containing over 800,000 items in its retrospective file and growing at a rate of about 5,000 new items each month. This file appears in both published and mechanized form twice each month. The published journals are available to anybody at an annual subscription fee of $76.50/95.65 for STAR and $160/175 for IAA. The first figure reflects the cost for domestic users; the second figure is the cost for foreign users.

We at the KAS Center have the entire unclassified NASA file on magnetic tape. We receive a new, up-date tape every month. In addition, we have almost a complete microfiche file of the N-documents, and access to microfiche or hard copy of all the A-type documents. These materials are available to us as a NASA Regional Dissemination Center.

The Regional Dissemination Center is one of many mechanisms used by NASA in implementing its mandate to make available to the non-aerospace sector of the economy the scientific and technological information comprising the NASA file.

NASA had two ways it could take in disseminating information. The first was to organize a new government department for this specific function and have it administered by civil servants. This smacked too much of empire building and it did not fit in very well with the concept of benefit to the non-aerospace sector of the economy.

The second approach was to contract with a non-government organization willing and able to undertake such a task. Once again, NASA was faced with two alternatives: (1) award the task to a profit-making organization motivated by the dollar; or (2) award the task to a non-profit organization motivated by a desire to serve the community.

Two important factors served to negate the profit-making organization idea. The first related to a sincere concern that the profit motive might have an adverse affect on the administrative and operational policies of a contractor to the detriment of the user. The second factor related to the natural reluctance of any profit-making organization to reveal its current or future research strategies to a commercial information service.

A non-profit organization such as a university was an ideal mechanism because its orientation to community service on a non-profit basis was a natural--from NASA's point of view. Such an organization must maintain the highest degree of integrity or it could not survive in the community it wished to serve. It could and would be trusted by the non-academic community.

Thus, the RDC experiment was initiated in the early 60's.

Today there are six such centers in operation: one is the Western Research Applications Center (WESRAC) at the University of Southern California; another is the Technology Applications Center (TAC) at the University of New Mexico in Albuquerque; the third is the Aerospace Research Application Center (ARAC) at the University of Indiana in Bloomington; the fourth is KASC at Pitt; the fifth is the New England Research Applications Center (NERAC) at the University of Connecticut in Storrs; and the sixth is the North Carolina Science and Technology Research Center (NCSTRC) in Durham, North Carolina.

Each of the RDC's receives the same NASA tape and serves its own community in its own way--independent of the other RDC's. Each of the centers has a complete set of abstract cards--one for every document in the file. NASA also sends us a microfiche of each N-type document accessioned into the file. Microfiche of A-type documents are obtained as needed from the American Institute of Aeronautics and Astronautics in New York.

## KASC RDC ORGANIZATION

The Knowledge Availability Systems Center at the University of Pittsburgh is conceived as an organization of personnel dedicated to teaching, research and operational activities in the field of Information Science. The primary mission of the Center is the integration of all its resources into a unified subsystem of the University complex for the purpose of serving the information needs of both the academic and non-academic communities.

The KAS Center was established in 1963 at the University of Pittsburgh by the late Chancellor Edward Litchfield and Professor Allen Kent--currently Director of the Office of Communications Programs at the University. The term 'knowledge availability' was chosen to represent an activity that is broader in scope than 'information retrieval systems' and to emphasize concern with nothing less than the total problem of assuring availability of knowledge for desirable social purposes--whether now or in the future.

The KASC RDC efforts to successfully exploit the NASA file are concentrated in four major areas: Marketing, Technical Operations, Analysis and Engineering Consultation. Each of these areas will be discussed separately. However, in general, the mission of the Marketing group is to publicize the program within the proximate geographic area of the University of Pittsburgh. It is their function to convince all segments of the economy within the area that the NASA file is a scientific and technological reservoir of information having a real potential value to them, and that they could and should exploit it to their advantage.

The Technical Operations group has the responsibility for processing all profiles through the system and for timely service from receipt of the customer's query to submission of search output.

The Engineering Consultant group provides a technical expertise which is utilized to the client's benefit by phrasing his profiles, maintaning periodic contact with him and general interpretation of the technical content of identified citations.

The Analysis Section also provides technical expertise which is applied just as in the Engineering Consultant group. In addition, this group provides an Information Science expertise which is utilized in the preparation of search strategies and for the successful exploitation of both mechanically and manually searched files.

Currently, there are 31 personnel assigned to the NASA RDC at KASC. The total excludes the Director of KASC and his staff who together maintain a degree of administrative and overall budgetary control over the NASA T/U Program.

Sixteen of the personnel assigned to the RDC activity are full-time professional and nonprofessional staff members of KASC. In addition, there are three part-time professional and six part-time clerical personnel on the payroll. The remaining personnel are full-time faculty and staff members of the School of Engineering.

## Engineering Consultants

This group is comprised of senior members of the faculty and staff of the School of Engineering at the University. Together, these personnel form a spectrum of scientific and technological competence which is applied to the client's needs.

These consultants are assigned to the client's profile, not to the company as an entity. Also, the assignment is made on the basis of the technical disciplines associated with the client's interest areas. Thus, depending on the number of interest profiles and the disciplines involved, a single client may have one or more consultants assigned to serve him.

The group currently comprises six personnel servicing KASC on a functional basis and is under the direction of Walter E. Turkes, Associate Dean of the School of Engineering.

Dean Turkes is responsible for establishing technical contact with new participants in the Program, maintaining technical liaison throughout the service period, and implementing periodic contact at the management level of the client organization. On the basis of these technical and managerial contacts, Dean Turkes advises the KASC Associate Director responsible for the RDC operations as to any action needed to improve KASC/client relationships.

Each of the engineering personnel has academic responsibilities which comprises the major portion of his work load. However, that part of his time which is devoted to KASC clients is recognized as implementation of a formal commitment by the University of Pittsburgh to the RDC activity.

These subject specialists meet with client representatives to phrase interest profiles and, depending on the type of service desired, they review computer output to screen out system 'noise,' maintain periodic contact with their counterparts at the client's establishment, and report to the RDC administrator the results of each of their contacts.

Before describing the procedure by which subject specialists are assigned and customer service is initiated, it may serve the interests of the reader if a description is presented of the composition and function of the Information Analysis Section. Both the KASC engineering consultants and the information analysts work so closely together that they are more frequently than not throught of as a single entity.

## Information Analysis Section

The function of the analysis group is to successfully exploit the technical content of the RDC files to the benefit of the participating clients. In implementing this function, the group relies heavily on the engineering personnel who provide in-depth subject expertise and who act as consultants in a limited capacity related to the technical contents of identified citations and the application of this technical information to the client's needs.

The analysis group currently comprises a complement of six personnel, five of whom are professional. The nonprofessional is the secretary. The professional cadre includes two full-time and three part-time personnel.

These personnel are all subject specialists who are technically competent in their own right. Without exception each has an undergraduate degree in a physical science or technical discipline. In addition, all but one has at least one graduate degree in either a physical science or Library and Information Science.

Four major factors differentiate the analysis section from the engineering consulting group:

(1) The consultants have greater in-depth expertise in their subject areas.
(2) The analysts have greater in-depth expertise in reference sources and searching techniques.
(3) The analysts have greater in-depth expertise in formulating computer search strategies.
(4) The analysts are part of the line organization of KASC--the consultant group is only a functional unit of the Center.

The talents of both groups are so complementary that when assigning a subject specialist to a profile, the discussions between Dean Turkes and the group's manager are based on the two groups being one subject-specialist pool of talent. However, if an 'engineer' is assigned to a profile, the computer search strategy is prepared in consultation with an information specialist.

## Technical Operations

The mission of the operations group is the timely processing of all inquiries, from initiation of service to submission of requested documents. The group personnel perform all the manual tasks associated with the group's mission, including the compilation of statistics related to system performance and effectiveness. In addition, this group is responsible for maintaining records on a per unit basis of all services rendered to each participant who exploits the files.

The group comprises a total of 13 employees--11 of the 13 being clerical or secretarial types and include both full-time and part-time employees.

### Services

KASC provides two basic services: current awareness searches and retrospective searches. However, because they are offered in combination, we refer to these basic service elements as being available at KASC:

(1) Current Awareness Service
(2) Retrospective Service
(3) Current Awareness and Retrospective Service in Combination

Current Awareness Service. This service is initiated with a search of the first tape received from NASA/Washington after the participant has formally requested service of KASC. The normal service period comprises a search of each of 12 consecutive monthly tapes.

Retrospective Service. The retrospective search exploits the files backwards in time. Its objective is to identify all documents in the file which are relevant to the requestor's interest profile.

The NASA tapes covering the period of 1962 through 1967 have been reformatted at KASC and comprise four tapes, two of which cover the period 1962 through 1965 and the other two of which cover the years 1966 and 1967. These tapes require strategies using the index terms in the NASA Subject Authority List (SAL).

The 1968 period saw the beginning of indexing using the NASA Thesaurus. Accordingly, a new set of retrospective tapes is being used for accessions beginning with the search period 1/68. Thus, a retrospective search, to be complete, will require a search with SAL strategies for the period 1962 through 1967 and a search utilizing a 'thesaurus' strategy for the 1968 and on period.

Current Awareness Plus Retrospective Service. This service is simply the combination of both types of searches applied to a single customer profile. Service may be initiated by a partial retrospective (to test the search strategy) or by an initial C/A (also to test the strategy) before performing a complete retrospective and continuing on a C/A basis.

Here is how the system works. Let us assume that you have decided to participate in the RDC activity. Our first action would be to contact Associate Dean Walter Turkes (who chairs the Engineering Consultant group) and inform him of your decision. In addition, we will request that he contact you to arrange a meeting. In all probability Dean Turkes will first call you to acquire a general understanding of your information needs.

This first contact is primarily to identify the technical disciplines involved in your area of interest. On the basis of these technical disciplines, a subject specialist will be assigned to your respective interest area. For example: an electrical engineering or electronics question will probably be assigned to a professor in the School of Engineering whose field of specialization is electrical engineering. A metallurgical question would go to a member of the Materials and Metallurgical Department, a question on polymers to the Chemical Engineering Department and a question on structures to the mechanical engineering specialists.

Thus, you may have one or many consultants assigned to service you depending on the number of questions you enter in the system and the technical disciplines involved in your areas of interest.

When the technical disciplines have been identified, a meeting is arranged between you and the RDC subject specialist. The objective is to identify and record the background of your interest area so that a natural language profile may be phrased.

When we have phrased your profile, it is converted into a boolean-type search strategy for computer searching. Specially prepared technical dictionaries are utilized for synonyms and related terms. Connector words are used to link the terms together, and the complete list is matched by the computer against the tape containing the NASA file.

The computer output is a list of accession numbers of those documents in the file which contain the same index terms as your profile. For each accession number identified, an abstract of the document is pulled and submitted--not to you--but to the subject specialist assigned to your profile. The specialist evaluates the abstract in order to eliminate any noise which may have crept into the system and to ensure that only relevant literature is submitted to you.

Here the system enters into a most important phase. When the relevant abstracts are identified by the subject specialist, they are transmitted to you with an evaluation and a document order form. Each abstract submitted to you is listed by accession number on this form. To the right of the accession number, you the recipient (and in the end analysis the best judge as to what you want), will place a check-mark in the appropriate column indicating whether you judge the abstract relevant to your profile or nonrelevant to your profile.

I cannot stress too strongly the importance of this feedback. With it we can broaden your strategy, narrow it, or change it completely. Without it, our usefulness is limited.

To the left of the accession number, and also by a check-mark, you can order either a full hard copy of the document or microfiche of the document. If available, we will furnish them to you.

Thus, the cycle is complete--from question analysis to document retrieval.

About five years ago it became apparent that the RDC experiment was not likely to achieve its goal on the basis of only a single NASA generated information file. The NASA file, as extensive and comprehensive as it is, is still a mission oriented file. Its potential for exploitation could be enhanced by accessioning discipline oriented file. Thus, the RDC network concept came into being.

This concept envisioned each RDC becoming a center of excellence in respective fields--avoiding duplication of effort and minimizing duplication of resources. Thus, KASC was to spin the Chemical Abstracts Service CONDENSATES and Chemical Titles files for the network: ARAC the Engineering Index file; North Carolina the DDC and GRA tapes; and NERAC the ASM METADEX file.

Today the network provides access to approximately 15 mechanized files containing over 3.5 million items and growing at a rate of almost 55,000 items per month.

But this is only a start.

Technology is for real. It has a role to play in our society. A powerful and positive role--in spite of the critics who--in the words of Lawrence Lessing--writing in Fortune Magazine-picture technology..."As a powerful juggernaut, with an internal momentum of its own, relentlessly pressing on with irresponsible developments, out of control." Not so.

We live in an era of change--an era characterized by increasing interfaces between our academic, governmental, industrial, business and social institutions. The sheer size and complexity of these monolithic and complex organizations of both the public and private sectors of our society require a new technology--to cope with the administration of these organizations.

The leaders of our human activities in both the public and private sectors are competent professionals whose talents we need in all areas of our society. But they have parochial loyalties and responsibilities which have priority over service to the community.

In addition, the problems of our society are 'interdisciplinary'. In a very real sense they require the attention--not of a single institution--but of all our institutions. And, the interface between these human institutions, if it is to be productive and contribute to the benefit of society demands the availability of more information about the environment in which these institutions operate; more information about day-to-day operations; more information that is accurate, complete and effectively communicated; more information which is directly relevant to the needs of these institutions so that their leaders can meet their primary responsibilities and still be in a position to give of their time and talents and energies to the involved social problems which beset our society today. It is a sad commentary on the effectiveness of our current information handling techniques that some 50 percent of the costs of running our national economy are information costs.

The library, our traditional information handling tool, has been unable to meet the information challenge of this era of change. On the other hand, the stepchild of the library--the computerized information system--has fared no better. We, at the University of Pittsburgh, believe a major factor contributing to the failure of both these disciplines to meet the information challenge is that they have been protagonists whose respective champions have been most parochial in their interests--looking inwards rather than outwards, more concerned with catalogs and file organization or collection building and file size rather than service to the user--service that he needs, when he needs it, and in the form that he needs it. However, in spite of their failure to meet the information challenge, the interface between these two disciplines is where progress will be made.

We planned to utilize the interfaces between the traditional library, the computerized information services, and the system user to achieve positive results in meeting the information challenge. We, therefore, proposed the development of a campus-based information system--an information system combining both traditional and computerized techniques, planned, developed, organized and operated as a dynamic, interactive system, serving the defined interests of our academic and non-academic communities on a regional basis.

That there is a need for a campus-based information system is a basic premise for our information activities at the University of Pittsburgh. However, we recognized that a need can exist, but no market; or a market but no customer.

For example, 30 years ago when Pittsburgh's steel mills belied the existence of the sun at high noon, the need for pollution control could not have been more apparent, but--there was no market.

Today, the need for an effective information system exists. Also, a market for information services exists. However, not many customers exist who can afford the cost of the entire system. Thus, our hope was that the development of the campus-based information system we proposed would be financed by: (1) the academic community; (2) appropriate state and federal agencies; and (3) local and regional industrial and business organizations.

Others agreed with our dreams. We succeeded in obtaining the support of our University. The National Science Foundation is supporting us and industry is supporting us through fees paid for KASC services.

Today, we are in our fourth year of a 10-year program to marshall the information resources of our community into an effective, dynamic system serving both the academic and non-academic communities.

One of the first steps in this activity was the establishment of the Office of Communications Programs under the direction of Professor Allen Kent. This office is responsible for education, research, and operational activities in the field of Information Science.

In the academic area our activities now encompass an undergraduate enrollment of approximately 250 students, a master's level enrollment of about 300, and a doctor's level enrollment of 100. All this from a start of one in 1963.

Our research activities stress the behavioral aspects of information systems and is concerned with man-machine interfaces. In this area, the Information Utilization Laboratory serves two major purposes: first, it serves as an access point to the information resources of the system; and second, it collects and systematically records all possible data on the information search activities of the area in order to evaluate the adequacy of the system--not only as a whole but also in its individual parts, e.g. the inquiry process, the service provided, and even the degree of utilization of the end product itself--information. One other factor was to characterize an IUL, it was to be designed to serve specialized fields of activity.

Currently, three IUL's are in operation. The first was designed to serve the engineering community. It is located in the Bevier Library of the School of Engineering and accesses technical files in both batch and interactive mode.

The second IUL is designed to serve the social science community. In contrast to the engineering IUL which outputs data from existing files, that for the social sciences is engaged in the compilation of data files as well as exploitation of existing ones.

The third IUL is located in the Hillman Library of the University of Pittsburgh and currently is designed to provide interactive access to the morgue of the New York Times. The data bank as of this day goes back to and includes coverage of the year 1969. Anyone whether a student, faculty member, staff member or just plain Joe Citizen may access the file. Currently there is a back-log of users and the queue wait is about 45 minutes long.

The system has the capacity to identify the total number of citations matching the search strategy, displaying any or all citations in calendar time sequence and print out any citations desired.

These IUL's in their operational service-oriented mode are incorporated as an arm of the Office of Communications Programs which comprises a remote computer center and its seven job entry stations; the University library system encompassing approximately 28 libraries; the KAS Center; the University representation in EDUCOM an affiliation of academic institutions working toward sharing of computer capabilities.

This paper would be incomplete without a few examples of KASC transfers.

## Coating Process

A small Ohio based manufacturing company was interested in coating their iron heat exchanger with a material that could withstand temperatures up to 1200°F, be corrosion resistant in natural gas during cycling, have at least

0.9 emissivity for infared radiation in the 4-12 micron range, and also be "stretchable" so that the coating would expand and contract with the base iron.

They came to KASC for help.

We were able to retrieve for them hundreds of relevant abstracts cited by the computer. One particular document described a coating process that stayed within the company's stringent specifications. This new coating now saves the corporation $5 on each of the 8,000 heat exchangers that they manufacture annually. Simple mathematics tells us that as a direct result of KASC assistance, the organization new realizes an annual savings of $40,000. The investment in the Center?...less than $1,000.

### Ship Design to Turbine Design

In early 1969 a large manufacturer of industrial turbines contacted the KAS Center for the purpose of obtaining information on the subject of "automated design".

Relevant abstracts included one entitled the "Design of Ship Structures by Means of Non-linear Programming Techniques". This paper described the exact procedure for reducing computer time for structure design to only a fraction of that which had been previously experienced. This computer aided design program was easily and successfully adapted to the problem of turbine design by the company's engineers.

The adaptation of technology from ship design to turbine design proved to be so successful that the corporation organized a new group of four engineers to continue computer design of equipment on a regular basis. The new procedure has significantly cut down the backlog of design problems and has resulted in an estimated annual savings of between $25,000 and $30,000 for the organization. The KASC investment of this user?...less than $1,000.

### Two-Year Project Eliminated

A multimillion dollar manufacturing concern was interested in developing a new process for hard facing steel valves. Specifically, the company sought a broad background on the different processes in use throughout industry. The problem was referred to KASC and a search of the NASA file was initiated.

The mechanized search resulted in over 250 citations, including documentation of a new shielded plasma jet spraying process describing the coating of a mild steel plate with a new type of cobalt sintered alloy. Subsequent examinations of the microstructure, hardness, density and bonding strength of the coatings were carried out with excellent results. The company soon installed the necessary equipment at their valve manufacturing facility in North Carolina where the process is now in operation.

The entire search took only three weeks at KASC. An engineering consultant has estimated the value of this documentation in terms of research time alone to be equivalent to a two-year, $170,000 research project.

### Flame Fusion Furnace

A small, Western Pennsylvania Company was in the business of manufacturing single crystals. They contacted us and asked if we could provide them, through our technology transfer program, with innovative techniques related to crystal growth.

Their very first search yielded 138 documents--all considered to be extremely pertinent by KASC experts.

The information provided by one of these NASA generated documents was directly responsible for the design and construction of a flame fusion furnace capable of growing ruby crystals of laser quality nearly three times as large as those grown in the older furnace.

A worthwhile investment? An estimate by the president of this organization attributes direct sales increases of at least $95,000 to this single KASC document. The company's investment in the Center was less than $500.

# INTERNATIONAL INFORMATION SYSTEMS FOR PHYSICAL SCIENTISTS

by

Charles K. Bauer
Manager
Technical Information Department
Lockheed-Georgia Company
Marietta, Georgia 30063

## SUMMARY

This paper discusses the numerous sci-tech information sources which provide retrieval service to outside users. Description of these sources was made by means of a questionnaire sent to centers throughout the world. Based on the response, information about these sources includes their name and address, subject fields and kind of collection maintained, retrieval systems employed, publications issued, and services supplied. In assessing international information retrieval and transfer, problems of the information seeker, industrial and technological conditions among nations, source selection, accessiblility, duplication, standardization, and language barriers as influences upon information receipt and utilization are discussed. A review is given also of cooperative efforts made by government-sponsored world organizations and international professional bodies to ameliorate prevailing conditions.

## THE SEARCH FOR SCIENTIFIC KNOW-HOW

To lecture on the acquisition of information in different fields and in different countries is a mammoth task. To do justice to such a lecture would require at least a year of concentrated study, and by the time one thought the study complete many changes would have taken place. Some information centers would have ceased to exist, others would have to be added; names, purposes, collections, and systems also would have changed. Another problem associated with this topic is the ever-increasing amount of literature generated, together with changes in source selection and the technology of retrieval. Consideration also must be given to political situations, socio-technological progress in developing countries, and other endemic national factors. What one may take for granted, however, are the never-ending changes in a country's improvement in the field of science and technology and, with that, the continuous search for information from sources throughout the world. The scientist must rely on the proper retrieval of new sci-tech information and innovations and simply cannot survive without applying the scientific and technological experience acquired by others. Therefore, the scientist has learned to apply the latest state-of-the-art information to his creation or product and we information experts must help him find that information.

Man creates, shapes, and destroys and, in turn, man must keep up with science as it creates, shapes, and destroys. Man has come to discover that through the written word, the power of knowledge is the strongest instrument in every field of undertaking. Borders of countries have become imaginary lines, oceans between continents have shrunk to lakes, and telecommunications have been developed to the point that man can destroy his fellow man and his land with the push of a button. Man realizes that he does not live in a vacuum oblivious to all which goes on about him. Psychological and physical isolation only can doom a culture. And since history teaches us that the pen is mightier than the sword, we have learned that the sword destroys but does not build.

### The Power of Information

What, then, remains to bridge the human race but an international way of thinking and acting? And what is more powerful than the written word -- the power of communication, negotiation, sharing -- by means of the release and exchange of the state-of-the-art in every discipline and endeavor? This is the topic of this lecture, one which underscores the availability of the written word and the state-of-the-art. Such sharing of scientific know-how is accomplished through a common tool -- INFORMATION. It must be made available and exchanged not just locally or even nationally but internationally. Information must cover the state-of-the-art and, in its broadest use, obviate unnecessary duplication of effort, thus saving manpower, time, and costs. We information scientists are charged with a tremendous responsibility: not only must we find and give the right information, reliable and relevant to our needs, but we also must make it available in a useful form to those who need it.

## THE PROBLEMS IN INFORMATION DISSEMINATION

We cannot emphasize enough the importance of scientific and technical information to our civilization. Although we information scientists are cognizant of the power of information as a management tool, problems in information dissemination are abundant. For instance, in the development, improvement, and utilization of a given product, there remain problems apposite to the acquisition of shared knowledge and experience gained by others and the rapid collection, analysis, and release of this information. The accessibility, completeness, and effectiveness of this knowledge are decisive factors in the acceleration of scientific and technological progress.

Although we are deluged with information of all varieties, we do not know whether a design actually is new or, instead, possesses just a localized novelty. This and similar questions may be answered only after one becomes familiar with the state of national or world technology in a particular field. In order to meet our objectives, we must familiarize ourselves with state-of-the-art information throughout the world. The only way to do this is by searching all extant publications and by no means is this task an easy one.

### How Much Information

Although no exact figures have been issued lately about the state of world publications, we might accept the many assumptions and statistical formulae which assert that approximately 100,000 scientific and technical journals are published annually throughout the world in at least sixty languages. Furthermore, in excess of 400,000 patents are registered annually and 250,000 scientific reports are annually written and deposited. This constitutes only 20% of all research and design work performed! Comparing these figures with those given by Charles Bourne in "The World's Technical Journal Literature: An Estimate Of Volume, Origin, Language, Field, Indexing, And Abstracting," (1) the annual increase since 1962 would seem to confirm these figures.

It is said that 1,500 pages of text are printed daily throughout the world in the form of books, journals, and reports for each specialist working in his specific field. The ICSU Abstracting Board estimated that within a one-year period more than 13,000,000 pages of original scientific literature were written or printed worldwide. Considering that engineers and scientists neither are aware of the available literature nor are taught how to extract the latest information from it, one realizes the important role the information scientist plays in the dissemination of scientific information. His knowledge of foreign languages, sources of national and international information, means of automation and mechanization of information work and computer technology, methods of abstracting, annotating, and editing, and the technical means of selection, acquisition, retrieval, analysis, and dissemination of information are major components of the information scientist's educational know-how. The lack of this knowledge and experience, hence, reduces the means of obtaining requisite information when needed.

## THE BOTTOMLESS WELL OF INFORMATION

While the education of professional librarians, documentalists, and information scientists is a major problem in the successful administration of sci-tech information, another as important, and more pertinent to this lecture, lies in the acquisition and availability of information. In yesterday's and this morning's lectures, we were exposed to sources as they are available in the United States. Applying proper dimensions to the task of knowing possible sources and obtaining information expeditiously, one presently must contend with a labyrinth of worldwide information sources. What is reflected is an almost bottomless well of information-generating institutions and related organizations. How to find the right information and where, that is the question!

To undertake a survey of worldwide information sources available, as I did, is a mammoth task, almost impossible to complete and virtually obsolescent when compiled.

For a rational and systematical approach toward information seeking, one would start locally and expand, step by step, to the international level. One then would find oneself on a merry-go-round of multitudinous information sources -- libraries, document depositories, information centers, analysis centers, *ad infinitum*. Upon further investigation, it would be revealed that such services are not merely complementary but, rather, duplicated and replicated.

Such an hierarchical schema would proceed from minime, up through minor, parvus, magnus, major, and maximus, viz., going from the local level to state institutions, to regional networks, national sources, international information systems, to international councils and professional organizations.

As one wends his way through this labyrinth, he encounters unforseeable problems and, necessarily, has to clear his confused state of mind in order that he may acquire the state-of-the-art. These acquisition problems are many, but the most important would seem to be: the socio-technological application; source selection; accessibility; limitations to access points with concomitant governmental vs. private need-to-know issues; standardization; and the language barrier. Let me review these briefly.

## THE SOCIO-TECHNOLOGICAL PROBLEM

### The Right Information For The Right Job

Once man realized that he had to utilize his fellow-man's know-how in order to prevent the reinvention of the wheel, he turned to the written word in his quest for information. Following our information seeking pattern, one may discover that the technology he seeks is based on know-how completely alien to his country's own experience, expertise, or state of science. This is particularly true if the information seeker is from a developing country, in which even the state of the economy has an influential role. The lack of certain tools, the level of technological understanding, and the lack of materials, financial resources, and professional and skilled labor all can have bearing in the application of the know-how once discovered.

In other words, innovation in industry means something quite different when it concerns not established industries in the industrialized countries but the emerging industrial sector in the developing countries. In industrialized countries, technological progress is expected, and even taken for granted. The availability of experienced engineers with their scientifically-trained minds, financial and natural resources, and the social environment of workers all contribute to change the methods, equipment, and scope of technological progress. Under these conditions, then, the application of technological know-how to the results of laboratory research and development or simple trial and error become the principal ingredients for innovation and scientific progress.

In the developing countries, the road to progress is harder. It is not the lack of will-power or pride in one's country but the lack of skilled workers in comparison to agricultural workers and artisans, the lack of industrial facilities, industries, and the traditions derived thereof, and halting socioeconomic progress which influence industrial progress greatly. In such an environment it is not a question whether the technology used in such cases is the most advanced one but, rather, to make sure that it is the most appropriate one for local conditions. Hence, securing the latest state-of-the-art is more applicable to highly-industrialized countries, whereas developing countries require a gradual uplift in technological know-how to bring about the innovation which represents industrialization, at whatever level of technology this may occur.

### World Organizations And Their Influence

#### UNIDO

It is for this purpose that the United Nations Industrial Development Organization's (UNIDO) Industrial Information Clearing-House was created. (2) UNIDO, created by a resolution of the United Nations' General Assembly in 1966 and based in Vienna, seeks to promote and accelerate industrialization in developing countries. The Industrial Information Section, under which the Clearing-House operates, seeks to promote the establishment of industrial information centers in developing countries. Its service is one which taps extant sources of information and transmits information to inquirers. Sources of information are concentrated mainly in industrially-advanced countries, although they also may be found in developing countries themselves. Answers to inquiries are supplied in the form of photocopies of articles, reports, tailor-made studies and references to new services and publications. UNIDO's Information Clearing-House also provides the services of selective dissemination of information on user profiles to be extracted from all publications received by the UNIDO Library. Satellite information centers are maintained worldwide, e.g., Africa, the Americas, Asia and the Far East, Europe, and the Middle East. The monthly *UNIDO Newsletter* provides news in all activities, expert services required, samples of questions received, and information sought by developing countries or that offered by industrial organizations located throughout the world.

#### OECD

Another organization which assists developing countries in their struggle for technological and economic survival is the Organisation For Economic Co-operation and Development (OECD) with headquarters in Paris. (3) Established in 1960, one of OECD's objectives is the achievement of the highest sustainable economic and technological growth and employment and a rising standard of living in member countries. To meet this goal the Committee For Scientific and Technological Policy was founded in the belief that economic and technological growth is based on knowledge and that such knowledge must be exchanged and integrated within economic and political systems. Such exchange of knowledge becomes INFORMATION, the raison d'etre of the Information Policy Group created in 1964. Its charter calls for the development and promotion of the concept of information policy in exploring the possibilities of international systems and economic conditions underlying their efficient use. In applying information to the growth of developing countries, the Information Policy Group's Ad Hoc Committee On Scientific and Technical Information in "Information For a Changing Society" stated:

> "The problem of scientific and technical information seems to be closely linked with economic growth from two different points of view. On the one hand, the diffusion of information throughout the scientific and technical community facilitates effective progress in research and development; on the other, information transfer offers industrial management the chance of taking optimal production decisions on a sound basis." (4)

Thus, the Ad Hoc Group seeks to: (1) explore the nature, magnitude, and implications for the needs for scientific and technical information and data in science, the economy and society, and how these needs may be met through changes in the structure, technology, and policy and management concepts in relation to information; and (2) present this conclusion and recommendations for the developing role of scientific and technical information and data systems and the policy and program resources required for them to fill the role effectively in member countries. To assist developing countries further in applying these policies, OECD maintains a central library in Paris and publication depositories in thirty-two countries throughout the world.

#### UNESCO/FID

Aware of the importance of scientific and technical information to the further advancement of developing countries, the United Nations Educational, Scientific and Cultural Organization (UNESCO) and the International Federation For Documentation (FID) surveyed the present position and possible future developments in this field. In the course of this work the two organizations studied national structures for documentation and library services in countries with different levels of development, with particular reference to the needs of developing countries. (5) Their study assessed trends in the development of documentation and library service, the degree of governmental control over documentation and library services, the structure and problems of services performed, and the educational level of professionals in libraries and documentalists. Collected from libraries and documentation and information centers in Africa, Asia, Europe, North America, Latin America and Australia, a comprehensive bibliography of these centers is appended in that survey.

#### UNISIST

UNISIST, an arm of UNESCO, is another major international organization which extends its services in this area. The Division of Scientific and Technological Information and Documentation within the Science Sector of UNESCO acts as the UNISIST Executive Office. While UNISIST's activities in promoting international sci-tech information cooperation are many, its principal objectives are:

(1) Improving tools of systems interconnection;

(2) Improving information transfer;

(3) Developing specialized manpower;

(4) Developing science information policy and national networks; and

(5) Special assistance to developing countries

In the sphere of socio-technological assistance and with the financial assistance of UNDP, UNISIST initiated a project for the establishment of a Regional Information Network for Indonesia and Southeast Asia, with Australia and Korea being considered for inclusion at a later date. (6) UNISIST assistance will consist of: (1) reinforcing national centers; (2) training information specialists; (3) training sci-tech information users; (4) improving and extending information services; and (5) introducing the necessary compatibility elements and the links between the national information centers.

Another valuable UNISIST project is the publication of a *Handbook For Scientific and Technical Information and Documentation Services In Developing Countries.* This *Handbook* will provide the information seeker in developing countries with relevant knowledge in the basic concepts, objectives, and functions of information collection and transfer, including current state-of-the-art on mechanization, technology, and standardization.

### WAITRO

While extant information centers and their release of subject information is the cardinal consideration of this lecture, sources of information providing referral services is another topic which the information seeker views as being quite as important. The World Association of Industrial and Technological Research Organizations (WAITRO) is an association of eighty six independent, nonprofit technological research organizations in developing and advanced countries. Its purpose is to provide mutual assistance among its members in the area of industrial technology and to act as a referral center and source of technological information and technical assistance to developing countries. Working closely with UNIDO, WAITRO plans to publish a *Handbook Of Technical Information Sources* in 1974.

Because the socio-technological problem affects all developing countries, many more world bodies have concentrated upon assisting and furthering cooperation among these countries. Although this also applies to the exchange of information, the topic is such a broad one that only a few of the extant programs have been mentioned.

## SOURCE SELECTION

### The Where And How

In reviewing the illimitable bibliographies and directories of information centers, one cannot help but become confused about the variety of information sources listed. Seldom is it stated in exact terms their holdings, services, availability to outside users, procedures for submitting inquiries, or the time frame in which a reply may be expected. To select the right source from all those listed is like finding a needle in a haystack. A contemporaneous situation exists, somewhat paradoxically, which is diametrically opposite to this; namely, many information experts in their quest for information are unaware of the sources to approach. Although librarians and documentalists are trained in information retrieval, are they competently trained in source selection? How well is the untrained scientist who does not have a library at his disposal able to deal with all the "unknowns" inherent in this situation? What about those many on-line computers and expanded networks with their sophisticated technology? How does one use them? What steps need to be taken to enlarge the scope of the search when the required information is unavailable at the first point of contact? It is apparent, then, that one would direct his inquiry toward a reference collection, hoping that this would lead to the next source of contact. How often have we information scientists done this only to end up with a feeling of frustration when we receive a negative reply after many weeks of waiting? In such instances, we cannot surrender so easily; after all, what kind of information experts would we be were we not to persevere? Therefore, we ascend that hierarchy of information centers -- from local to state to national to international -- hoping not just that we get the information but also that we get it in time to make use of it. Then, too, how often have we experienced the unhappy fact that because of the transfer of inquiries from place to place or because of the confrontation between man and machine -- this lack of personal contact -- the information we finally receive is so distorted that it is entirely useless?

### Referral Services

Although we encounter professional courtesy in being referred to possible sources while traveling on the many crossroads of discovery to obtain needed information, it is, nevertheless, a long, drawn-out, and haphazard journey. In many cases, we may get our information in piecemeal form -- here a bit, there a bit, or only a part of it. Why, then, is there not an international referral center for sci-tech information? An umbrella organization, such an international referral center would serve as a means to interconnect users and sources of information. Upon addressing an inquiry to the referral center, the information seeker would be given a list of sources most likely to have what he needs. Although such a center does not have to be a full-scale data bank, it must have access to all kinds of data banks, e.g., individual, state, and national. Although this idea is not new, similar referral centers, but not in the sci-tech field, already have been developed or are in a pilot stage. They have been established not only on a national level but also on an international level.

### International Referral Systems

While I shall cover such referral centers in more detail in the area of national and international networks, let me cite a few extant world organizations and their efforts to achieve a more even flow of information acquisition. One such international referral center is that initiated by the United Nations Environmental Program. (Although source selection in the environmental field will be covered by another lecturer, I would like to point out the availability of such an international referral service). Even though their International Referral System is presently in a pilot phase, I hope it will become a permanent institution soon. (7)

### UNISIST

Also quite involved in the many facets of information exchange, standards, education, and policies is UNISIST. One of its long-term objectives is the establishment of a world network of interconnected referral services for the purposes of:

(1) allowing users to switch to the most appropriate services according to their particular needs;

(2) analyzing the characteristics of extant information services with respect to coverage, subject categorization, cost policies, language, etc., so as to increase the knowledge of primary and secondary sources of information; and

(3) detecting "anomalies" in the worldwide distribution of analytical work. (8)

### CAN/SDI

Another important tool which reduces the time for source selection is an effective SDI system. While some national SDI services are operating, there remains a long way to go for such services to become effective on an international basis in the information transfer effort. The Canadian government, by means of the UNISIST Program, has offered to assist UNESCO member states in establishing a national SDI system along the lines of the proven CAN/SDI system. (9) Such national SDI systems provided through the Canadian National Research Council of the National Science Library (NRC/NSL) would be another step in establishing an international network by linking all national SDI systems together.

The "Nuclear Network" of information sources with the International Nuclear Information Services (INIS) constitutes another focal point for the information seeker. FID, ISCU, and OECD are a few more organizations which are attempting to create switching points in the flow of information. All seek to create a mighty river of information sources for the irrigation of man's mind.

### FID Directory

Even though there are a few organizations attempting to establish international referral centers, mostly through the use of computerized networks, the old, conventional bibliographical approach flourishes. Indeed, it has proven to be a friend in need. While many directories list worldwide information centers, libraries, and their holdings by subject, one of the most used ones is *National Technical Information Service: A Worldwide Directory.* (10) It is being updated by FID and will be known as *National Referral Services: Worldwide Directory.* Because there are many good conventional referral sources, I have appended a comprehensive bibliography.

### Aslib

Looking at other conventional referral centers, there are those of the various professional societies, of which Aslib (Association of Special Libraries and Information Bureaux) is the most widely-known in Britain. Founded in 1924, it has been, for the last fifty years, the principal focus in the United Kingdom, with 28% of its 2,500 members dispersed throughout seventy-four countries outside of the United Kingdom. Aslib acts as a referral center for individuals or organizations seeking to locate sources of information on any subject. Inquiries by members are answered by carrying out searches in the literature or by putting the inquirer into contact with other organizations or individuals who may be able to help. Approximately 65% of Aslib's inquiries pertain to scientific or technical subjects.

## STANDARDIZATION, ACCESSIBILITY, AND LIMITATIONS THEREOF

### The Limited Access

Assuming the information seeker has located the right source to acquire needed information, he may encounter a "closed-door" policy quite frequently. Although we survived the so-called post World War II information explosion, which brought with it the tremendous growth of information centers and sophisticated retrieval systems, "need-to-know" requirements are still retained. Originally conceived because of national defense activities, "need-to-know" restrictions are still employed by many information centers before parting from requested information. Although these information centers initially were oriented toward national defense efforts and, hence, had a limited availability to the general user, most inter-governmental organizations and those industries working on an industry/government concept of contractual relationship continue to mark some of their documents "limited distribution." Because of the recondite ways of bureaucracy, these limited reports rarely find their way into the scientific community. In many cases, the inquirer must address his request through governmental channels. This is a very frustrating, time-consuming, and confusing approach of "sharing" the know-how for the benefit of scientific and technological development. Similar restrictions include those in which information is available only to "society members" in good standing. If a non-member needs information to pursue his goal of bettering society, he, quite simply, is out of luck.

### Standardization Among Access Tools

Then, too, there are those areas in which computers are the middle-men in the information transfer process. If one does not have any knowledge of computer languages or retrieval systems, matters are greatly complicated when trying to utilize these sources. Lastly, while a successful literature search depends on available tools and accessible resources, it is the skill in selecting the right subject area and applying appropriate descriptors which is the real secret in obtaining useful results. The result hinges on eliminating multitudes of documents, sometimes numbering in excess of several hundred entries. Thus, the selection of proper descriptors -- largely dependent on knowing the technological problems involved and applying scientific know-how in the subject area -- is a quality expected of the information expert. Only an expert with such technological and terminological experience can perform a successful literature search. Yet, even such experience in the performance of a successful search is conditional upon his awareness of the vocabulary used, the input of descriptors, the depth of the indexing system, the range of the subject area, the thesauri applied, and the detail of retrieval capability. Although these factors comprise the key to successful retrieval, unfortunately they are not applied uniformly.

Another obstacle to ease of information retrieval concerns the absence of standardization. There are manifold classification schemes in existence, various indexing systems developed by heterogeneous information centers, different modes of application in information systems, and the usage of literally hundreds of abstracting services based on publishers' abstracting guides, indexing lexicons, and computer tapes. All have been prepared by diverse nationalities and countries, in myriad languages, and applied to every variety of publication. This certainly is not a new problem but because of its complexity and size, standardization has been applied only to a few areas. This is one area which requires a lot of study and cooperation.

### CODATA

A successful attempt was achieved recently in the area of numerical data applicable to symbols, units, constants, terminology, and nomenclature and toward adequate indexing of the substance and properties covered by all data compilation projects. This task was performed by the Committee On Data For Science and Technology (CODATA), organized in 1966 by the International Council of Scientific Unions (ICSU). As Guy Waddington said in his paper, "CODATA -- Its Organization, Activities, and Goals," CODATA seeks to provide coordination and guidance for worldwide data-compiling projects. (11) From its headquarters in Paris, CODATA publishes a semi-annual *Newsletter*, supplying information on the formation of network groups, publication of new reports, bibliographies, meetings and discussions, and other new developments. CODATA's latest contribution in the area of standardization is the publication of a book, *International Compendium Of Numerical Data Projects.* (12)

### Standardization In Information Science

One of the most important contributors in the formulation and programing of worldwide standardization in information science is UNISIST. Although it has many ongoing projects, its most embracing and far-reaching concerns the establishment of a standardization program for all phases of information handling. Its ultimate goal is the gradual evolution of a worldwide science information system. This will call for conversion of computer programs with a view toward establishing interconnections between systems that are not directly compatible. Another project on standardization is that of the development of an internationally acceptable coding system for periodical titles. This will be undertaken by the International Serials Data System (ISDS) and supported by a number of National Serial Data Programs (NSDP), such as the one in the United States in progress since 1972. ISDS seeks to promote international standards for bibliographic description, communication formats, and information exchange in the area of serial publications as well as with the facilitation of scientific and technical information retrieval in serials.

An additional advantage is the planned publication of a *Reference Manual For Machine-Readable Bibliographic Descriptors,* a worldwide reference manual with standardized bibliographic description. This should prove to be a useful tool for different people in different places and working in different languages as it will create an identical record given the same input data. Moreover, by meeting the needs of secondary information services for an agreed minimum set of bibliographic data elements for interchange between computer-based systems, an additional advantage will accrue.

### INFORMTERM

Also working within the framework of the UNISIST Program is the International Information Center for Terminology (INFORTERM), established in 1971 and located in Vienna. This organization works in conjunction with the Austrian Standards Institute. Its purpose is to collect worldwide terminological publications on standards and specialized dictionaries and to disseminate information on terminological publications, libraries, and their sources for possible interconnection into terminological word banks. Although UNISIST has supported this and other standardization projects, implementation also has occurred in other fronts of information transfer. COSATI terms, for instance, which received widespread acceptance in the United States in its governmental abstracting indexes, have now been adopted by a broad spectrum of international abstracting publishers.

### Standardization and Nuclear Information Sources

Standardization has been implemented most significantly in the area of nuclear research and its information exchange system. With the establishment of the International Atomic Energy Agency (IAEA), the European Atomic Energy Community (EURATOM), and now OECD's Nuclear Energy Agency (NEA, formerly ENEA), in addition to other national, regional, and even commercial Atomic Information Institutions, worldwide cooperation in information and documentation has come into being. With this phenomenon, standards for ease in retrieval operations through data banks have been adopted. Accessibility to these centers rarely is limited to the general user because these institutions are interested in the peaceful application of nuclear energy. A more complete description of these centers will be given later when I discuss national networks. I should add the proviso that many more projects are in operation or will be formulated in the future because of the obvious advantages which standardization yields in information retrieval.

## TRANSLATIONS

### The Language Barrier

Source selection, accessibility, and interchangeability of information systems are not the only problems with which the information seeker is confronted. An inherent problem in the acquisition of worldwide information is the language barrier. Approximately 60% of sci-tech publications are written in English. Considering that in excess of 100,000 journals and 250,000 reports are published annually in sixty languages, and that the English language accounts for 60% of these, there are fifty-nine remaining languages being used to write about 40,000 journals and 100,000 reports.

### Foreign Coverage In World Abstracting Tools

*Chemical Abstracts,* which strives for complete coverage of the world's published literature, reports that United States journals abstracted by them in 1970 comprised 27.4%. The figures for the Soviet Union are 23.6%, Japan with 7.2%, and other foreign countries with 41.8%. Of these, 56% were published in the English language. (13) We have been given to understand that 1973 figures do not drastically change the general picture.

Coverage in AIAA's *International Aerospace Abstracts* (IAA) in 1973 totalled 35,560 journal articles, meeting papers, conference volumes, and so forth, of which 12,639 were from the United States, the remainder from foreign countries. These citations include 2,167 translations of Soviet Union journals. Once again, English accounts for most of the statistics with 24,422, or almost 70%, whereas 11,138, or 30%, were written in another language. (14)

NASA's *Scientific and Technical Aerospace Reports* (STAR) publishes between 8,000 to 10,000 reports annually, of which 35% constitutes foreign input. Although no precise total figure exists for reports issued in the United States, it is estimated that this figure could be as high as 100,000, of which the National Technical Information Service (NTIS) indexes approximately 50,000, 10% of which goes abroad. (15) Based on the world figure of 250,000 reports and 100,000 journals issued annually, the 60% English-generated vs. 40% non-English-generated template appears to be a safe assumption.

During 1973, the Defense Documentation Center (DDC) accessioned approximately 33,600 documents, of which 10% were of foreign origin. (16)

The BioSciences Information Service*(BIOSIS) 1973 List of Serials* contains 7,980 serial titles published in 102 different countries, of which 21.53% represented the United States. (17) It should be noted in this case, however, that the gradual growth of literature from Europe and the Middle East, Asia, Australasia, and Africa resulted in a decline in the relative percentage of literature originating in North, Central, and South America.

**1973 Country Breakdown Of Published Literature For BIOSIS**

| Area | Percentage |
|---|---|
| Europe and Middle East | 50.80% |
| North America | 24.29 |
| Asia and Australasia | 14.89 |
| Central and South America | 6.97 |
| Africa | 3.02 |

The use of foreign material received and published in *Engineering Index* is 21%, representing forty-eight countries and fifteen different languages. (18)

To overcome the language barrier, UNESCO is sponsoring the publication of a multilingual thesaurus with inputs of many extant multilingual dictionaries. The International Standards Organization's (ISO) Technical Committee was asked to organize a symposium of expert users of these multilingual thesauri for an exchange of viewpoints and guidelines and for attempted standardization.

### Translation Exchanges

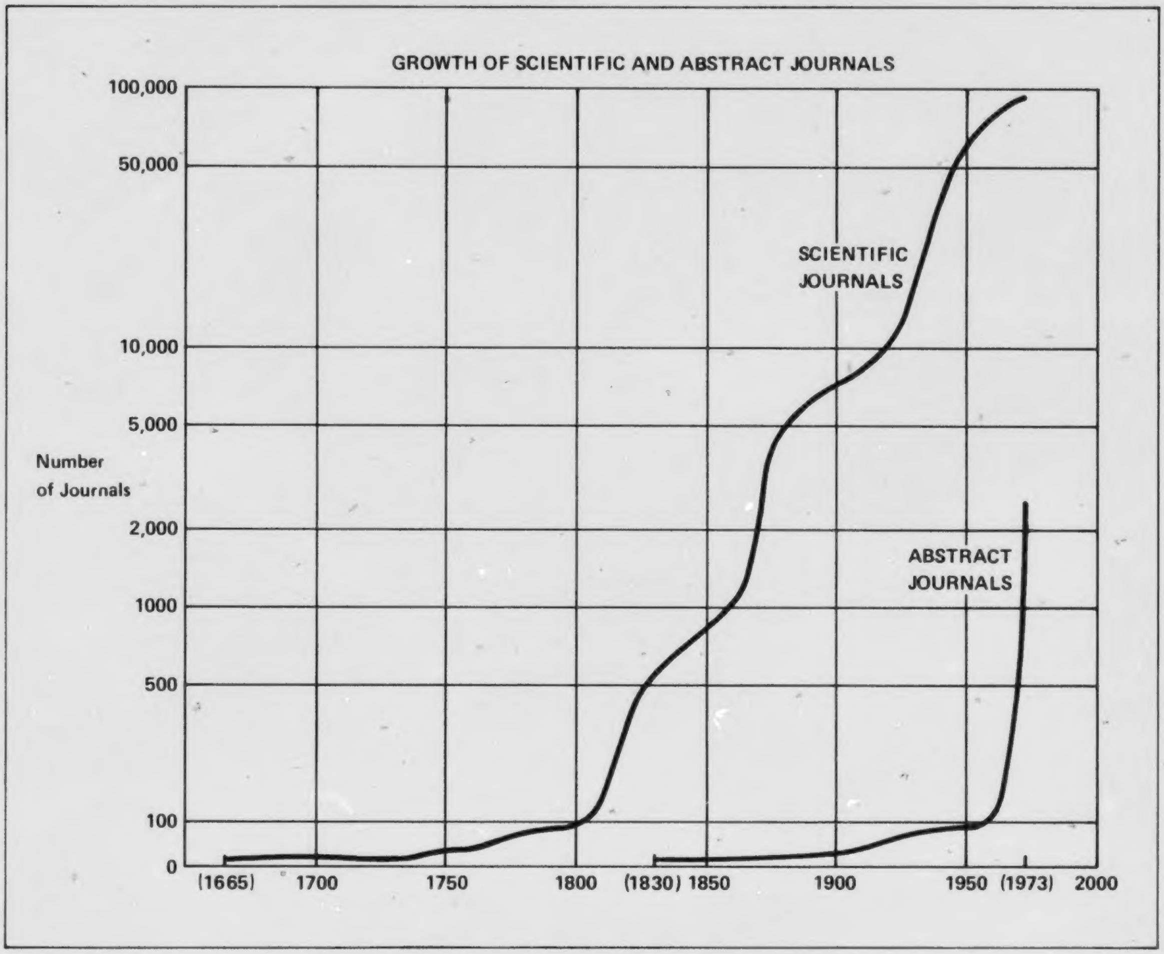
To further the exchange of information, many government-sponsored translation projects and commercial and professional societies translate, for instance, Eastern journals cover to cover into English and other publications and patents into various languages. The John Crerar Library in Chicago maintains a National Translations Center which collects, but does not generate, translations voluntarily submitted to them from sources throughout the United States. The British Library (BL) in England also collects, but does not generate, translations sent to them throughout the continent. Both the John Crerar Library and the British Library prepare photocopies of their holdings and, for a small fee, release them to inquirers. Aslib is another source which receives inquiries for translations as it maintains the *Commonwealth Index of Unpublished Translations.*

### European Translations Centre (ETC)

The European Translations Centre (ETC) in the Netherlands was founded in 1960 by OECD. ETC maintains close contact with a number of national centers and many cooperating organizations throughout the world. Although the European Translations Centre does not itself prepare translations, it does serve as a clearinghouse for sci-tech translations prepared primarily from Eastern European, Middle Eastern, and Far Eastern languages into Western Languages, especially English, French, and German. Its principal function is to keep a central reference catalogue and to operate an information bureau to handle requests for translations. ETC issues a monthly *World Index Of Scientific Translations And A List Of Translations Notified To ETC.* These translation services represent only the beginning. Others, of course, are being planned or are in operation. We also should mention that each country has translation services which play an important role in the application of information to technological progress.

## ABSTRACTING AND INDEXING SERVICES

Having discussed the significance of translations to scientific publications, I must mention the role of the world's abstracting services which cover these publications and serve as important reference and retrieval tools. J. Martyn, in *Secondary Services and the Rising Tide of Paper,* states that between 1,000,000 to 1,500,000 journal articles are published annually. (19) Considering that these articles comprise part of 100,000 journals written in at least sixty languages, the manner in which they are brought to the attention of users certainly is very important. Since 1830, when the first abstracting journal, *Chemisches Zentralblatt,* was published, more and similar services have been established, e.g., *Engineering Index* in 1884, *Science Abstracts* in 1898, *Chemical Abstracts* in 1907, and so forth. Today, more than 2,600 services exist throughout the world. It is interesting to note that these abstracting services grew somewhat analogously to that of scientific journals.



In Stella Keenan's and Marna Elliott's article, *World Inventory Of Abstracting and Indexing Services,* (20) we find that NFAIS' *Guide to the World's Abstracting and Indexing Services In Science and Technology,* published in 1963, contained 1,855 titles from forty countries, with 365 United States services included. (21) A compilation of abstracting services published by FID in 1969 lists an additional 816 entries in the sci-tech field.

### World Inventory Of Abstracting and Indexing Services

In 1971, UNISIST in cooperation with FID and NFAIS entered into a joint project to create a worldwide inventory of information on abstracting and indexing services covering science and technology and the humanities and social sciences. The inventory, in machine-readable form, will be capable of cross-indexing and sorting and of being searched by various file access characteristics such as subject, country, and language. This also will constitute a reference tool for librarians, information specialists and other users in the form of a machine-based, authoritative worldwide directory of secondary services available for all commonly known media.

### ICSU Abstracting Board

Another world body in the area of sci-tech information coordination is the International Council of Scientific Unions Abstracting Board (ICSUAB) which regularly brings together two important groups of organizations concerned with the literature of science: the international and scientific unions and the abstracting, indexing, and information services. The International Unions which belong to the ICSU form a link among scientists in all countries. The Abstracting, Indexing and Information Services plays a very important role in making available to the world's scientists the information contained in hundreds of thousands of scientific and technical papers published annually. Some ICSU programs in the area of abstracting are:

(1) Assisting member services to improve their coverage of literature and to minimize the delay in publishing abstracts;

(2) Encouraging authors of scientific papers to adhere to UNESCO's guide for the preparation of author's abstracts, thus helping to improve mutual understanding among the world's scientists;

(3) Studying the needs of users of abstracting and information services throughout the world;

(4) Developing common classification schemes and identifying gaps and overlaps in subject coverage; and

(5) Planning and forecasting the future development of abstracting, indexing, and information services in order to achieve the most effective evolution of these services.

These various activities undertaken by central bodies by no means are the only ones concerned with better coordination, standardization, and publication of abstracting and indexing services. Since at this time I am interested only in available services, additional references to and services supplied by abstracting and indexing installations will be covered in the description of the main available services or in the Appendix of this lecture.

### Major International Abstracting and Indexing Services

Mention should be made of the principal abstracting services used by the international clientele. In reviewing those questionnaires received for my survey, it was interesting to note that a rather large percentage of information centers use American-generated sources, e.g., *Chemical Abstracts, Biolgoical Abstracts, Engineering Index,* AIAA/IAA, NTIS/GRA, NASA/STAR, AEC/NSA, MEDLARS, and so forth. These and others are procured for use by information centers by means of the appropriate index, securing accessibility through the use of magnetic tape, through direct computer application, or through a network system hook-up.

### INSPEC

Generated as a joint international venture by the Institute of Electrical Engineers, the Institute of Electronic and Radio Engineers, and the Institute of Electrical and Electronics Engineers is the abstracting service offered through INSPEC (International Services In Physics, Electrotechnology, Computers and Control.) With the publication of *Science Abstracts,* encompassing *Physics Abstracts, Electrical and Electronics Abstracts,* and *Computer and Control Abstracts* as well as a *Current Paper* series in physics, electrotechnology and control, article entries are provided from 2,000 journals and reports, 9,000 patents, and 500 conferences proceedings. INSPEC offers an integrated range of information services covering current awareness and retrospective search tools for use by individual libraries. An SDI service covering all of INSPEC's data base also is available. INSPEC's data base is available on magnetic tape for individual subscribers or for a share-type service.

INSPEC is the largest information retrieval network covering the entire electronics field; METRON provides current awareness on instrumentation; and ISMEC covers mechanical engineering.

## INTERNATIONAL DATA EXCHANGE AND NETWORKS

Large reservoirs of technical information published by numerous abstracting services may be found in the various international distribution centers and computer networks, created in attempt to organize such services into a world service organization. Computer networks are extant nationally, regionally and internationally. Such networks once they become international, may be linked further together, thus creating a world body of information sources ready to serve as "the referral center" of the world. As I mentioned earlier, such an attempt is being made by many world organizations, including UNISIST, OECD, FID, ICSU, and EUSIDIC. The European Association of Scientific Information Dissemination Centers (EUSIDIC), established to provide better coordination among its members, is an organization whose membership includes most of the chief information dissemination centers currently operating in Europe. While it does not itself offer any services, it is concerned with the coordination of policies and practices which bear on the successful development of such services in a European context.

### World Information System for Science and Technology

Many other organizations by now have come to the conclusion that cooperative sharing through networks is a desideratum as no single institution could afford the cost of acquiring all available information resources and equipment. Once libraries and information centers throughout the world developed programs to facilitate the sharing of their resources, regional information systems were born. With the gradual merger of computer/communications, computer techniques in information retrieval were applied in information transfer. Locally applied at first, it spread, emerging in many countries as national networks. Although costly, these networks are very much in demand. Their use and application for information transfer in various countries will be discussed later in this lecture.

FID, a proponent of international computer networks, recommends:

> "...that there is a pressing need to study and to analyze the experiences in a number of countries in creating or optimizing national information systems; to define the place of information centers within national, regional and international information systems; and to undertake the elaboration of a general concept and structural scheme for a worldwide system." (22)

It is interesting to note that UNESCO's UNISIST recommends as part of its aforementioned five programs, i.e., Developing Science Information Policy and National Networks, that preliminary consultation with other countries be held concerning the further creation of international information centers based, if possible, on extant national information centers. This program was launched in 1969 to undertake a feasibility study on the establishment of an International Information System For Science and Technology Policies and to establish subsequently a World Information System For Science and Technology. (23) The seriousness of this program is illustrated best by the fact that joint meetings are occurring between UNESCO and FID apropos to a World Science Information System. While these two official world organizations -- and others -- recognize the need for such an international information system, there are certain international "distribution centers of scientific information" extant.

### International Distribution Centers

In discussing international distribution centers, I would be altogether remiss if I failed to mention the good offices of AGARD. With its mission of bringing together the leading personalities of the NATO nations in the fields of science and technology relating to aerospace and of stimulating sci-tech advances in the aerospace sciences, a great corpus of excellent papers, conference proceedings, and lecture series are presented and published. These are made available through AGARD's national distribution centers in the NATO member nations. Similar services are provided by UNESCO's publication centers; by UNIDO through its *Guides To Information Sources;* OECD's library and its International Road Research Documentation (IRRD) services; and so forth.

### Worldwide Nuclear Network

The most successful application of this international exchange of information has been accomplished in the nuclear field, particularly in the area of non-military uses of atomic energy. Associations covering Europe include the European Atomic Energy Community (EURATOM), the European Nuclear Energy Agency (ENEA), the European Organization for Nuclear Research (CERN), and the European Atomic Forum (FORATOM). The International Atomic Energy Agency (IAEA) derives its membership from all parts of the world. EURATOM's information services are directed through its Information and Documentation Center in Brussels. With the assist of its computer services, it provides international dissemination of information to its community and the rest of the world. ENEA maintains a Computer Program Library at the Euratom Center in Ispra, Italy. Although CERN's Scientific Information Service's main task is to provide information services to the staff of its Laboratory, it also shares its holdings with others upon request. FORATOM, a nonprofit organization of atomic industrial associations, promotes its activities through meetings and conferences among its members on nuclear developments and makes its findings known through the release of its proceedings and other publications. The most widely-dispersed information activity is that of IAEA, with headquarters in Vienna. The Division of Scientific and Technical Information is the main source by which technical information is either collected or disseminated. Its holdings cover information produced by all its member nations and it cooperates closely with the U. S. Atomic Energy Agency (USAEC) in its publication of *Nuclear Science Abstracts* (NSA). In the last few years, IAEA and its member nations have worked on the design and implementation of an International Nuclear Information System (INIS). Governments and regional organizations, representing the source of at least 90% of the world's production of nuclear literature, have agreed to a cooperative worldwide program to collect nuclear science and technology information, assemble it by computer techniques, and redistribute it, either in the form of magnetic tapes or as a printed bibliography, *INIS Atomindex*. By merging these records, it will be the world's first computer-based documentation service for a whole range of nuclear information sources.

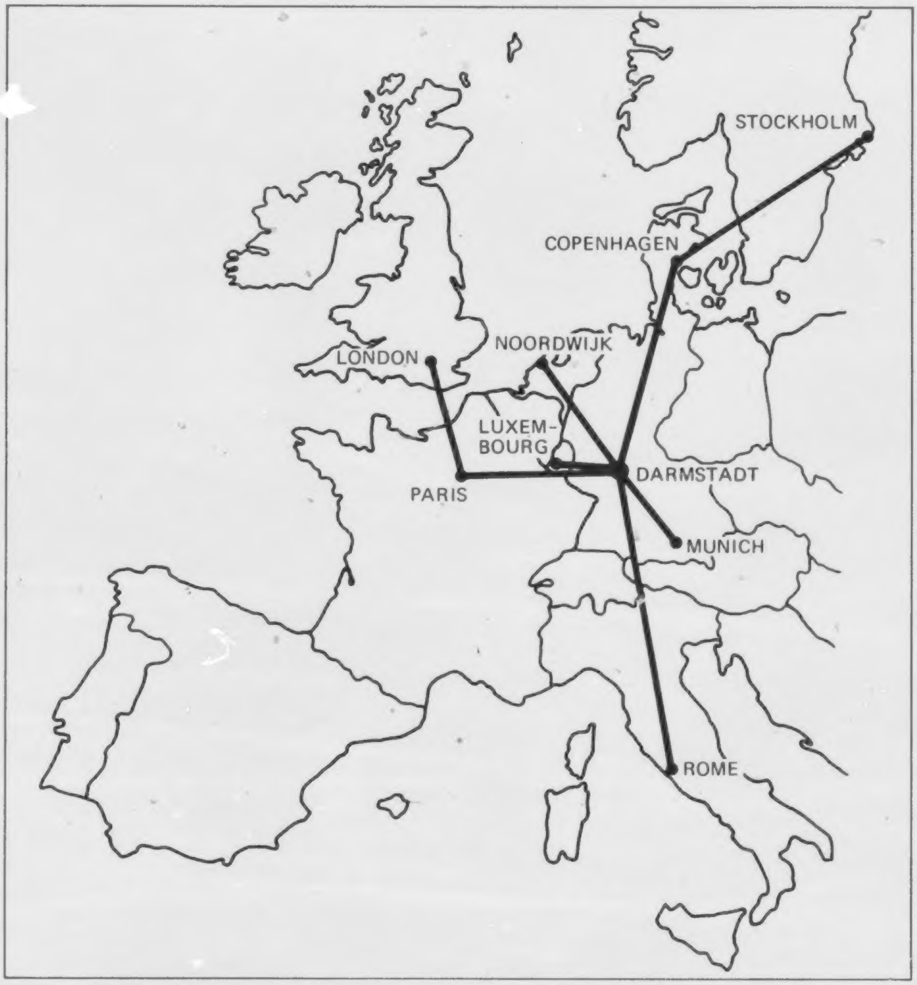
## Neutron Data Compilation Center (CCDN)

In 1958, the forerunner of the present OECD founded the European Nuclear Energy Agency (ENEA), now known as the Nuclear Energy Agency (NEA). In 1964, at the recommendation of the European-American Nuclear Data Committee (EANDC), OECD established the Neutron Data Compilation Center (CCDN) in Paris. Together with the National Neutron Cross Section Center (NNCSC) at Brookhaven in the United States, the Nuclear Data Section (NDS) of the International Atomic Energy Agency (IAEA), and the Nuclear Data Center at Obninsk in the Soviet Union, the CCDN forms part of a worldwide network. It also maintains close contact with the United States Atomic Energy Commission. (24)

## European Space Research Organization (ESRO)

Europe's largest computerized information network containing information about practically all subjects within the natural and applied fields of science and technology is the one operated by the European Space Research Organization (ESRO). (25) Their Space Documentation Service (SDS) teledocumentation display terminal network encompasses research stations in London (TRC); Paris (ESRO Headquarters); Luxemburg (CID); Darmstadt (ESOC); Copenhagen, Noordwijk (ESTEC); Stockholm (RIT); Munich (ZLDI); and Rome (ESRIN). The SDS network supplies retrospective bibliographies on the NASA/STAR and AIAA/IAA data bases, NTIS files, *Chemical Abstract* Condensates (CAC), METADEX *(Metals Abstracts)*, COMPENDENEX *(Engineering Index)*, ESRO data banks in the area of electronic components data and test results, INSPEC (Institute of Electrical Engineers), and NSA *(Nuclear Science Abstracts)*. Certainly a comprehensive and impressive selection of data!

ESRO/ELDO TELEDOCUMENTATION NETWORK FOR EUROPE



Courtesy of *La Rivista Dell' Informazione*

### World Data Center

Another major ICSU activity in science information concerns the international exchange of geophysical data through the World Data Centers (WDC). The World Data Center collects data in the geophysical and solar disciplines and issues periodic catalogs. Any country in the world, whether a member of an international scientific union, another international organization, or even non-members, may participate in the international exchange of geophysical data through the WDC's.

### Patents

Though discussed less often as a source of information, patents are vitally important to scientific and technological progress. About 1,000,000 new "patent documents" (specification of inventions as contained in patents, inventors' certificates,.and published specifications for the same) are published annually throughout the world. They represent an immensely valuable source of scientific and technological information reflecting the most recent technical achievements. There are many national information centers which collect and maintain patents outside of their respective governmental Patent Office. Such centers include the Technische Informations Bibliothek in Hanover, Federal Republic of Germany, which also maintains a complete collection of all German DIN's (standards) as well as many from Switzerland, Austria, and Great Britain; the Library of the Swiss Federal Institute of Technology in Switzerland; the Library of Technological University Dept. in the Netherlands; and the Scientific and Technical Documentation Centre of Turkey (TURDOK).

### ICIREPAT

One leading center for the collection of patent literature is ICIREPAT (Paris Union Committee For International Cooperation In Information Retrieval Among Patent Offices), a part of the World Intellectual Property Organization (WIPO) located in Geneva, Switzerland. The objective of ICIREPAT it to promote international cooperation in the field of storage and retrieval of technical information needed in connection with the search or examination of applications for patents, inventor's certificates, or other similar documents. This objective is realized in part through the Shared System Program. Quintessentially, this program consists of agreed-upon guiding principles and procedures for the cooperative design, development, and testing of shared use systems for the storage and retrieval of patents and other sources of technical information. Twenty-two countries, including the United States, presently participate in this program, and the International Patent Institute in The Hague. (26)

## AVAILABLE INFORMATION SOURCES: A REVIEW

Having covered information sources in light of various problems and proposed solutions and having reviewed plans for improving international information centers (based, for the most part, on sharing systems by linking extant national information centers or networks), let me discuss now some of these centers -- their location, collection, and services. As I mentioned in my introduction, the information centers which are listed here are based on the return of inquiries and questionnaires in which I attempted to obtain up-to-date data. Not all the important information centers, local or national in scope, have responded, thus you may note certain omissions over which I, unfortunately, had no control. Since this Lecture Series is being held in Canada, Norway, and Italy, I have listed only token references to information sources there as I assume the audience knows its own sources best. I also must add that I had only a brief while to prepare this paper and to list every available information source is impossible. For this reason, only that portion of information centers which possess an international aspect in collection or services is listed. For those desiring additional information on this topic, I have appended a bibliography. It is categorized by information policy matters, technical articles on international systems and services, and bibliographies and directories with reference to libraries and information centers on an international scale.

### CANADA

### National Research Council (NRC)

Being an outsider, speaking to Canadians about information sources in their own country is much like "carrying coal to Newcastle." With Canada, in addition to the United States, the United Kingdom, the Nordic countries, and the Federal Republic of Germany, having one of the largest information resources in the Western hemisphere at its disposal, it is rather difficult to single out the main information sources and describe them sufficiently and eloquently. Like the United States, which has three national libraries, three major libraries form the real backbone in Canada. These are the Library of Parliament, the National Science Library, and the National Library of Canada. (27) The purpose of the latter two is to serve the entire country and for that reason, they have built a national information network serving all libraries and, at least indirectly, serving all Canadian citizens.

While I shall list several Canadian Libraries which responded to my questionnaire in my Appendix, I particularly wish to discuss three information sources which have contributed greatly to the information transfer process. As a matter of explanation, I am doing this for the benefit of non-Canadians who will attend this lecture in other parts of Europe.

I believe that one of the most important sources is the National Research Council with its Library, founded in 1925, and changed in 1966 to the National Science Library. Although NRC does not make available unpublished material and abstracting services, it does provide Canadians with two important services. One is the Technical Information Service (TIC) which, in association with the various Provincial Research Councils or Foundations, forms a free government service supplying secondary or processing industries with current technological information on properties of materials, manufacturing facilities, new industrial developments, and scientific research. Secondly, the NRC utilizes one of the most extensive computerized data banks providing an up-to-date SDI service. Known as CAN/SDI (28), it first covered Canada's Scientific and Technological Information (STI) network and now has expanded into a joint SDI program with the National Science Library, the National Library of Canada, and the Geological Survey of Canada. CAN/SDI, an on-line dialogue computer system, presently maintains ten data bases for scanning purposes, including CAC, INSPEC, MEDLARS, MARC II, COMPENDEX, and NTIS/GRA. One most encouraging program is Canada's offer to make CAN/SDI available to the UNESCO/UNISIST Program in establishing national SDI systems elsewhere which easily could be linked together to form an international SDI system.

## DENMARK

### Dansk Teknisk Oplysningstjeneste (DTO)

The Dansk Teknisk Oplysningstjeneste (DTO), or the Danish Technical Information Service, located in Copenhagen, was established in 1955. Since 1961, DTO has been affiliated with the Danish Council for Scientific and Industrial Research. As an independent institution, DTO's function and services are rather unique. Its chief field of activities includes contact and liaison services, question and answer services, active information services, conference and course activities, and consultation services. The last-mentioned is accomplished by having DTO information experts visit industrial concerns and research institutions to discover their problems and arouse interest in information service. In other words, they consider "information" to be a commodity and, as such, sell their wares to Denmark's scientific community. In the area of international collaboration, it is statutory for DTO to be at the disposal of the Foreign Service in order to insure that report material be utilized and that contact with industry be improved. Furthermore, it is statutory that DTO cooperate with corresponding information services abroad, e.g., Nordforsk, Scandoc, OECD, UNIDO, and FID. Germane to the last-mentioned, DTO is one of the twenty-seven members on FID's Study Committee On Information For Industry.

### Denmark's Tekniske Bibliotek (DTB)

Denmark's Tekniske Bibliotek (DTB), or the National Technological Library of Denmark, is located in Lyngby and, since 1965, has been in the forefront where documentation services on magnetic tapes is concerned. This has given DTB influential access to the international planning of information networks; presently it is planning an on-line connection to the ESRO system. With the assistance of the Danish State's Central Computer Center's TELETEXT system, DTB developed an SDI service for chemical titles chosen from *Chemical Abstracts* with the consequent procurement of hard copies of the original articles. Additional data bases include CAC, COMPENDEX, and *Food Science and Technology Abstracts* (FSTA). On the international scene, DTB has expanded its SDI service considerably by releasing its TELETEXT software system. Since 1972, DTB has arranged share-service with the Netherlands, Belgium, Germany, the United Kingdom, and Italy. In one such mutual arrangement, the Netherlands operates the INSPEC data base for Danish clientele. While the services presently provide only for current awareness purposes, an on-line/dialogue service is under consideration.

## FINLAND

### The Valtion Teknillinen Tutkimuskeskus (VTT)

Functioning since 1942, the Valtion Teknillinen Tutkimuskeskus (VTT), or the Technical Research Centre of Finland, is a government office subject to the Ministry of Commerce and Industry. The Information Service of the VTT disseminates information in all fields of research pertaining to the research centre. Information services may be obtained not only by the research scientists affiliated with the Centre but also by industrial establishments in Finland either by means of direct commission or as part of contractual research performed by the laboratories. The institute has twenty-eight laboratories working in a broad spectrum of technological subjects, including metallurgy, radio technology, wood and timber, building technology, road construction, textile technology, soil mechanics, and leather research. The Technical Information Service Department is responsible for the editing and printing of publications and reports from the laboratories and conducts literature searches, supplies Xerox and photocopies, and provides reference services and interlibrary loans of material.

The information service of VTT is the Finnish national center for SCANDOC which acts as the procurement agency for American and Canadian publications. In excess of 2,500 publications are obtained in this way annually. VTT also extensively uses the services of the United States' National Technical Information Service (NTIS).

## FRANCE

### Centre National de la Recherche Scientifique (CNRS)

Under the sponsorship of the French Ministere de l'Education Nationale, the *Centre National de la Recherche Scientifique (CNRS), Centre de Documentation* in Paris, supplies laboratories, institutes, researchers, scientists, and technicians with scientific and technical documentation. Its publication, *Bulletin Signaletique*, contains abstracts of scientific, technical, and philosophical material published in periodicals throughout the world. More than 500,000 articles are covered annually. The Centre maintains a translation service, providing French translations of foreign language documents. This service keeps a current general inventory of translations, publishes a monthly catalogue of new translations, and works closely with the ETC. Rapid dissemination of bibliographic data is another service performed. The library, too, receives more than 13,000 periodicals.

## GERMANY

### Chemie Information und Dokumentation (CIDB)

Chemie Information und Dokumentation (CIDB) provides a nation-wide abstracting service in chemistry, in collaboration with the Internationale Dokumentationsgesellschaft fin Chemie (IDC) in Frankfurt, by releasing their tapes to IDC. CIDB's main activities lie in the areas of: (1) editing the printed abstracting service, *Chemischer Informationsdienst*, published weekly, containing about 23,000 abstracts annually; (2) encoding chemical compounds using the GREMAS- as well as the RINGCODE-system, both being fragment codes; (3) working as an output center, offering tape searches from CA-Condensates and CBAC; (4) serving as an input center for CAS evaluating German journals and patents; (5) cooperating with the European Metallurgy Information System; (6) publishing some special services, e.g., the *Trivialnamenkartei*; and (7) doing some developmental work such as compatibility studies.

## THE NETHERLANDS

### Technische Hogeschool

The oldest of the three technical universities, the Technische Hogeschool, or the Delft Technological University, dates from 1842. The Library and Information Service which covers all fields of technology serves as the National Technological Library of the Netherlands and is the source of information for Dutch industry. Incidentally, it also houses the European Translations Centre (ETC), mentioned previously. The staff perform literature searches and provide current awareness service.

It presently holds more than 4,300 periodical subscriptions and collects reports of governmental agencies and research laboratories, possessing more than 350,000 reports to date. Another service maintained by the University is the Central Technical Catalogue of the Netherlands which lists the holdings of 150 libraries of industrial and business establishments and institutes engaged in the fields of science and technology. The Catalogue serves as a location index or referral point.

## SCANDINAVIA

### Scandinavian Documentation Center (SCANDOC)

The Scandinavian Documentation Center (SCANDOC), founded in 1960, is operated by the national research councils and academies for technical sciences in the Scandinavian countries through their joint Scandinavian Council for Applied Research. SCANDOC is a nonprofit organization serving as a scientific and technical information exchange between the United States and Canada and the Scandinavian countries of Denmark, Finland, Norway, and Sweden. It assists the industrial and technical communities of the countries served by locating information and procuring and disseminating research reports and other literature not readily available through bookstores and other regular channels. Its scope and subject coverage comprises scientific and technical information of the North American and Scandinavian countries consisting of published, unpublished, and ephemeral literature. SCANDOC performs literature searches, reference and referral services. Its serial publications are the bi-annual *Scandinavian Research Information Notes* and the bi-annual *Scandinavian Research Projects*. Both are free and are distributed throughout the United States and Canada upon request.

## SWEDEN

### Swedish Institute of Building Documentation (BYGGDOK)

The Swedish Institute of Building Documentation (BYGGDOK) in Stockholm, founded in 1966 and sponsored by the National Council for Building Research, is the central national body for documentation in the fields of housing, planning, building, and civil engineering. The principal task of the Institute is to provide information to research workers, consultants, contractors, manufacturers, and others associated with the building industry. It operates a library in which copies of research reports, books, and journals are retained, processed, and abstracted. Dissemination of information assumes the form of the quarterly *Building Abstract Service*, a joint venture with Denmark, Finland, and Norway. It issues reports and bibliographies and provides information retrieval, literature searches, and SDI services. A member of CIB, BYGGDOK maintains close international relations with building research and documentation institutes in Denmark, Finland, and Norway and with other non-Scandinavian countries.

### The Statens Rad for Ventenskaplig Information och Dokumentation (SINFDOK)

The Statens Rad for Ventenskaplig Information och Dokumentation (SINFDOK), or the Swedish Council for Scientific Information and Documentation, is the central Swedish organization for scientific and technical information and documentation. SINFDOK, established in 1968, was created as an independent organization to handle all policy questions concerning scientific information and documentation in light of the growing need for systematization and planning in this field and the increasing necessity for international cooperation.

According to its instructions, SINFDOK will, *inter alia:*, (1) follow developments in the information and documentation field and lay down the guiding principles of policy with the aim of coordinating available resources; (2) be responsibile for the long-term planning of activities, initiate and promote research and development; and (3) handle international cooperation concerning information and documentation.

### Royal Institute of Technology (RIT)

Besides its educational functions for the Institute and other Swedish universities, the Royal Institute of Technology since its early beginning has been responsible for the task of providing Swedish scientists and industrial communities with direct and immediate access to publications and information required for their work. In 1969, the RIT Library no longer was a library in the conventional meaning of the word but, instead, an information center serving universities, industries, and research workers all over the country. At that time RIT initiated its computer run on-line/dialogue SDI service consisting of approximately 7,100,000 references. With financial support from SINFDOK, RIT now subscribes to sixteen magnetic tapes including those of CAC, INSPEC, METADEX, COMPENDEX, NTIS/GRA, NASA/STAR, ERIC, AEC/NSA, and IAA. Since the latter part of 1972, the RIT library has been connected with ESRO-Darmstadt, which added 1,200,000 additional references to its searching in dialogue techniques.

### Forsvarets Forskningsanstalt (FOA)

The Forsvarets Forskningsanstalt, or the Research Institute of National Defense, is the main organization for defense research in Sweden. Located in Stockholm, the responsibilities of FOA lie chiefly in the fields of chemistry, physics, electronics, nuclear sciences, medicine, and operations analysis. In cooperation with other military and civilian research organizations and with Swedish industry, FOA also engages in other fields of research, such as mathematics, materials research, documentation, international security policy, psychology, and so forth. In order to further the general progress in the fields in which it is active, FOA has adopted a policy of making available to the scientific community and the general public results of its research activities and surveys of certain fields of research. Apart from reports on current research having a more or less close connection with military projects and scientific papers published in international journals, FOA issues a number of publications containing information directed to those readers mentioned above. These publications are the FOA *Journal*, FOA *Reports*, and *Defense Research Abstracts*. The FOA Index is a section within the Research Institute of Swedish National Defense concerned with all aspects of computerized and computer-aided documentation, including extensive systems and computer program development. FOA's computer system is known as CORSAIR (Computer Oriented Reference System For Automatic Information Retrieval) and is shared by many Swedish government agencies. SDI services performed by CORSAIR include the use of tapes received from *Chemical Abstracts*, *Biological Abstracts*, IRRD, and the United States Library of Agriculture.

## TURKEY

### Turkish Scientific and Technical Documentation Centre (TURDOK)

The Turkish Scientific and Technical Documentation Centre was established in 1967 as a service of the Scientific and Technical Research Council of Turkey. It has four main divisions: (1) basic sciences; (2) natural sciences; (3) engineering sciences; and (4) technical documentation. Subject reports in basic and natural sciences are represented by physics, chemistry, mathematics, biology, medicine, agriculture-forestry, veterinary and animal sciences, behavioral sciences, and economics. The Technical Documentation Division is responsible for the organization and control of all reports obtained, and the collection of available preprints or reprints of symposia papers. It also handles the publications issued by the Centre, such as the series, *Key to Turkish Sciences*, which presents English abstracts of technical and scientific research publications to foreign and local research organizations, universities, libraries, and individuals.

The Centre operates nation-wide, being at the disposal of any scientist or technologist or scientific or technical organization in Turkey. Its services include bibliographic compilations, documentation, procurement and current awareness services, and reprography services. It now is in the process of establishing a competent translation service.

## UNITED KINGDOM

Here, as well as in Canada, information sources, collections and dissemination is so plentiful, so well-organized and publicized, that the British professional librarian or information expert should have no problem in locating the right source of information, if and when needed. Although it may become somewhat more complicated when it involves those who are not experts in the field or those from other countries, there are many good reference bibliographies, some of which are listed in the Appendix. The Department of Education and Science and Aslib are two important sources for inquiries about libraries and information centers. In the sphere of locating and obtaining information material, the British Council has established working contacts with British scientific information services, as listed in a specially-prepared list. (29)

Some of the major information sources, in addition to those listed in the Appendix, are the following:

### The British Library (BL)

The British Library was established under the provisions of the British Library Act of 1972 and formally came into being on 1 July 1973. The Library was formed from three major national institutions: The British Museum Library, the National Central Library, and the National Lending Library for Science and Technology. It is being re-organized into three main divisions: Reference, Lending, and Bibliographic Services. It is also planned to incorporate the British National Bibliography Limited in the Library. It maintains outside contacts with prospective borrowers through its Lending Division. The Lending Division combines the resources of the former National Central Library and the former National Lending Library for Science and Technology, and contains more than 1,750,000 volumes and 42,000 current periodicals. Books and periodicals normally are available on loan only to other libraries and corporate organizations in the United Kingdom. A photocopy service is maintained for organizations and individuals in the U. K. and overseas. The Lending Division has access to many millions of books in other libraries and is the national center for inter-library lending and information about books and for inter-library lending between Britain and foreign countries. It also includes a British National Book Centre for the distribution of redundant books from other collections. The Library has more than a million unclassified reports, many of which are held in the form of microfiche. These can be supplied as full size or as microfiche.

All HMSO publications have been collected since 1962

The BLL has also a collection of doctoral dissertations including those from many British universities, in excess of 250,000 translations into English are held, and approximately 48,000 conference proceedings have been acquired by the Library.

The objective of the BLL is to supplement the resources of libraries by providing a rapid postal loan/photocopy service. All interlending requests for the British Library now are sent to Boston Spa and it is expected that about 83% of items requested will be satisfied from the central loan stock. Should this fail, the BLL will try to satisfy requests with the assistance of other libraries in the U. K. and abroad.

### British Office for Scientific and Technical Information
### (Experimental Information Network to be established by OSTI.)

As part of a program of research into the application of on-line computing techniques to information storage and retrieval, the British Office for Scientific and Technical Information (OSTI) has recently recommended an experimental information network.

Facilities initially will be located at five institutions: the Cranfield Institute of Technology, Hatfield Polytechnic, the National Reference Library of Science and Invention, Newcastle University, and the University of Manchester Institute of Science and Technology.

During the experiment, access will be provided to a number of on-line systems and data bases. The data bases currently available are SCISEARCH 2 (Institute for Scientific Information) and RETROSPEC 1 (INSPEC). New data bases will be added to the network in due course, starting with a sub-set of MEDLARS available through the MEDUSA system at Newcastle University. The possibility of including data bases held outside the U. K. in the network will be investigated.

### Defence Research Information Centre (DRIC)

Although the primary function of DRIC is to serve the Ministry of Defence Establishments, Branches, and U. K. R&D defense contractors, its operation, consequently, is similar to that of the United States' Defense Documentation Center (DDC) with limited accessibility. The Defence Research Information Centre (DRIC) was set up in 1971 within the Procurement Executive, Ministry of Defence, by merging the defense and aerospace functions of the former Mintech Technology Reports Centre with the Naval Scientific and Technical Information Centre. It is the central facility of the Ministry of Defence for the acquisition of unpublished scientific and technical reports from the United Kingdom and overseas sources.

DRIC's services are available to Government Defence Departments and defense contractors in industry and universities.

DRIC's holdings include U. K. *Government Defence Reports,* U. S. reports from 1941 to the present (including a nearly complete set of NACA and NASA reports), and a complete and regularly-updated microfilm library of U. S. military specifications and related Federal specifications and drawings, MIL Standards, MIL Handbooks, and Qualified Products Lists.

Although DRIC's principal operations are concerned with controlled distribution documents, all reports which can be made openly available are designated "Unlimited" and copies are passed by DRIC to the British Library Lending Division and to the Department of Trade and Industry's Technology Reports Centre.

The report input is scanned and details of technical innovations arising from the U. K. Defence programs, e.g., new devices, construction, techniques, processes, etc., which have no security restrictions, are identified and details passed to TRC for exploitation by British industry through the Techlink service.

### AERE, Harwell, Heat Transfer and Fluid Flow Service Information Center (HTFS)

Harwell is part of the Ministry of Technology and serves governmental agencies as well as contractual private concerns. It is not only a testing center but also a respository and dissemination center for information in the area of nondestructive technology. The Information Service Section's objectives are to provide access to selected technical information relevant to heat transfer and fluid flow and related topics and to provide background information for HTFS Design Reports, for the confidential consultancy, and for the HTFS research program. Harwell informs the designer of current information and, from their information files, provides retrospective literature searches on specific topics.

In 1968, HTFS established its own reference library to hold selected worldwide literature on heat transfer and fluid flow. In excess of 15,000 documents now are stored in this library. These documents are primarily in the form of complete copies of reports, journal articles, books, symposia proceedings, and so forth. The documents are not available for loan. Photocopies of those documents which cannot be readily obtained from the usual sources can be bought from HTFS.

Recent additions to the HTFS Library are listed in its current awareness bulletin, *HTFS Digest,* which is collated and produced monthly by computer process. Additional publications include *Physical Property Information* and *HTFS Index* for design reports and research papers.

### Shirley Instute

**(Cotton, Silk and Man-Made Fibres Research Association, Manchester)**

Just as much as *Chemical Abstracts* INSPEC, COMPENDEX, *Biological Abstracts*, and others are used worldwide, so is *World Textile Abstracts*, published by the Shirley Institute. One of the world's leading textile research organizations, it has been continuously collecting, recording, and indexing world literature relevant to the textile industry for more than fifty years.

In 1969, the Shirley Institute, in collaboration with the British Launderers', the Hoisery and Allied Trades (Hatra) and the Wool Industries Research Associations (WIRA), published their combined digests of current literature in a new and twice-monthly periodical, *World Textile Abstracts*.

In 1972, the World Textile Abstracts Service (WTA Service) issued a rapidly-produced monthly and annual subject index on computer printout to assist information officers and others in the execution of their work.

Since 1969, work has been proceeding on the development of computer-based systems for the recording, storage, and processing of the records of literature covered by *World Textile Abstracts* so that additional information services can be made available. The Specialized Textile Information Service (STI Service) is being designed to both supplement and complement the WTA Service so that the two services together will provide a wide range of service facilities sufficient to meet every textile information requirement.

Since January 1970, the STI Service has made available a data base containing magnetic tape records of WTA-covered literature for use by computer-based information systems operating elsewhere.

### Department of Trade & Industry Technology Reports Centre (TRC)

Besides the British Library, the Technology Reports Centre is the main source for providing scientific and technical reports in the United Kingdom. The Technology Reports Centre is the Department of Trade and Industry's research and technical information center. It processes and makes available for industry and research centers exploitable and unpublished research and development reports arising from U. K. government programs and those of overseas governments. The Techlink Unit forms part of the Centre.

The Centre holds the majority of non-classified technical reports produced in government research establishments. In some cases report series go back to 1940. The Centre's holdings particularly are strong in electronics, aeronautics, materials technology, and mechanical, electrical and industrial engineering.

The Centre receives the openly-available reports of the U. S. National Technical Information Service and NASA, together with many reports from other U. S. and overseas organizations under exchange arrangements.

As new reports are received, they are announced in the Centre's fortnightly journal *R & D Abstracts*. Editions covering selected subject fields - aerospace engineering, electronics and communications, materials and manufacturing methods, and physics - are also available as information on request. Special bibliographies are prepared on subjects such as electronics reliability, fluidics, micro- electronics, welding and brazing, and so forth.

The availability and price of reports and publications is indicated in *R & D Abstracts*. Nearly all reports held by TRC can be purchased for the cost of reproduction and postage. The procedure for obtaining reports from other sources is given.

Technical inquiries to the Centre are handled by subject experts with access to very extensive subject, author and corporate-author indexes. The Centre also conducts searches on the computerized ESRO Space Documentation Service data bank. Files currently available include *Scientific and Technical Aerospace Reports (STAR)*, *International Aerospace Abstracts (IAA)*, *Nuclear Science Abstracts (NSA)*, *Metals Abstracts (METADEX)*, *Engineering Index (COMPENDEX)* and *Government Reports Announcements (NTIS)*.

Techlink is a new service for the rapid and selective dissemination of technological information to industry. It is aimed particularly toward those in industry concerned with research, development and design.

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(14) Letter to author from Miss Patricia Marshall, Chief Librarian, Technical Information Service, AIAA, dated 28 January 1974.

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(16) Letter to author from Mr. Hubert E. Sauter, Administrator, Defense Documentation Center, dated 24 January 1974.

(17) *BIOSIS 1973 List Of Serials With Coden, Title Abbreviations, New, Changed and Ceased Titles,* Bioscience Information Service of Biological Abstracts, Philadelphia, Pa., 1973.

(18) Letter to author from Mr. John E. Creps, Jr., Executive Director, Engineering Index, Inc., dated 31 January 1974.

(19) Martyn, J., "Secondary Services and the Rising Tide Of Paper," *Library Trends.* Vol. 22, No. 1 (July, 1973) pp. 9-17

(20) Keenan, S., and Elliott, M., "World Inventory Of Abstracting and Indexing Services," *Special Libraries*, Vol. 64, No. 3 (March, 1973), pp. 145-150.

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(26) Letter to author from Mr. Kendall J. Dood, Technical Counsellor, ICIREPAT Section, Industrial Property Division, dated 4 January 1974.

(27) O'Rourke, J., "Information Resources In Canada," *Special Libraries.* Vol. 61, No. 2 (February, 1970), pp. 59-65.

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## CONCLUSION

Throughout the course of this lecture I have taken special precautions to inform the reader that the *List of Worldwide Information Centers* is not a complete inventory of all extant international sci-tech information sources. Those which are listed represent only a small fraction of available sources. To make this *List* a truly valuable document for the information seeker would require additional research, particularly in locating, selecting, and including more extensive data for continents other than Europe. Such an expanded version then might be published as a book in order that information seekers everywhere would be able to find the right information sources, reliable and relevant to their needs.

## APPENDIX 1

## ACRONYMS

| | |
|---|---|
| AGARD | Advisory Group for Aerospace Research and Development (NATO) |
| AIAA | American Institute of Aeronautics and Astronautics |
| AIA | Association of International Libraries |
| ASTRID | Association Scientifique Et Technique Pour Le Recherches En Informatique Documentaire |
| BL | British Library |
| BSO | Broad System of Ordering |
| CA | Chemical Abstracts |
| CAC | Chemical Abstracts Condensates |
| CAN/SDI | Canadian Selective Dissemination of Information |
| CCDN | Neutron Data Compilation Center |
| CEA | Centre D' Etudes Nucleaires |
| CEC | Commission Of European Communities |
| CEDOCAR | Centre De Documentation De L'Armement |
| CEPT | Conference Europeenne Des Administrations Des Postes Et Des Telecommunications |
| CERCHAR | Centre Du Recherche Des Charbonnages De France |
| CERN | European Organization For Nuclear Research |
| CETIS | Centre Europeen De Traitement De L'Information Scientifique |
| CIB | International Council for Building Research Studies and Documentation |
| CID | Centre of Information and Documentation |
| CIDB | Chemie Information Und Dokumentation |
| CNDST | Centre National De Documentation Scientifique Et Technique |
| CNIDST | Comite National De L'Information Et De La Documentation Scientifique Et Technique |
| CNRS | Centre National De La Recherche Scientifique |
| COBI | Committee On Biological Information |
| CODATA | Committee on Data for Science and Technology |
| COMPENDEX | Computerized Engineering Index |
| COPANT | Pan American Standards Committee |
| COPIC | Computer Information Center |
| CORSAIR | Computer Oriented Reference System for Automatic Information Retrieval |
| COSATI | Committee on Scientific and Technical Information |
| CSIRO | Commonwealth Scientific and Industrial Research Organization |

**APPENDIX 1 CONTINUED**

| | |
|---|---|
| DECHEMA | Deutsche Gesellschaft Fur Chemisches Apparatesvesen |
| DFVLR | Deutsche Forschungs-Und Versuchsanstalt Fur Luft-Und Raumfahrt |
| DRIC | Defence Research Information Center |
| DRME | Direction Des Recherches Et Moyens D'Essais |
| DTB | Denmarks Tekniske Bibliotek |
| DTO | Dansk Teknisk Oplysningstjeneste |
| ECE | Economic Commission For Europe |
| Ei | Engineering Index |
| ELDO | European Space Lab (ITALY) |
| ELDOK | Electronic Documentation and Patent Association |
| ENDS | European Nuclear Documentation Center |
| ENEA | European Nuclear Energy Agency |
| ERIC | Educational Resources Information Center |
| ESA | European Space Agency |
| ESLAB | European Space Lab (Netherlands) |
| ESRIN | Space Documentation Service |
| ESRO | European Space Reserach Organization |
| ETC | European Translations Centre |
| EURATOM | European Atomic Energy Community |
| EUSIDIC | European Association of Scientific Information Dissemination Centers |
| FAO | Food and Agriculture Organization |
| FID | International Federation for Documentation |
| FORATOM | European Atomic Forum |
| FSTA | Food Science and Technology Abstracts |
| HTFS | Harwell Information Center<br>(Heat Transfer and Fluid Flow Service) |
| IAA | International Aerospace Abstracts |
| IACOD | International Advisory Committee on Documentation, Libraries, and Archives |
| IAEA | International Atomic Energy Agency |
| IBI-ICC | Intergovernmental Bureau for Information-International Computation Center |
| ICA | International Council on Archives |
| ICAITI | Central American Research Insititute for Industry |
| ICAO | International Civil Aviation Organization |
| ICIREPAT | International Patent Information Systems |

**APPENDIX 1 CONTINUED**

| | |
|---|---|
| ICOGRADA | International Council of Graphic Design Association |
| ICSU | International Council of Scientific Unions |
| IFIP | International Federation for Information Processing |
| IFLA | International Federation of Library Associations |
| ILO | International Labor Organization |
| INFOTERM | International Information Center for Terminology |
| INIS | International Nuclear Information System |
| INSPEC | Information Services in Physics, Electrotechnology Computers and Control |
| INSPEL | Official Organization of IFLA |
| IRRD | International Road Research Documentation |
| IRS | International Referral System |
| ISCED | International Standard Classification of Education |
| ISDS | International Serials Data Systems |
| ISIS | Integrated Scientific Information System |
| ISLIC | Israel Society of Special Libraries and Information Centers |
| ISO | International Standards Organization |
| ISORID | International Information System on Research in Documentation |
| ISSN | International Standard Serial Numbers |
| ITU | International Telecommunication Union |
| JICST | Japan Information Center of Science and Technology |
| KORSTIC | Korean Scientific and Technological Information Center |
| LIBER | League of European Research Libraries |
| METADEX | Metals Abstracts |
| NATO | North Atlantic Treaty Organization |
| NDS | Nuclear Data Section |
| NEA | Nuclear Energy Agency |
| NFAIS | National Federation of Abstracting and Indexing Services |
| NIDER | Nederlands Instituut Voor Informatie Documentatie En Registratuur |
| NLL | National Lending Library (British) |
| NLR | National Aerospace Library (Netherlands) |
| NNCSC | National Neutron Cross Section Center |
| NORINDOK | Norwegian Committee for Information and Documentation |
| NRC | National Research Council (Canada) |
| NRC/NSL | National Research Council/National Science Library (Canada) |

## APPENDIX 1 CONTINUED

| | |
|---|---|
| NSA | Nuclear Science Abstracts |
| OECD | Organisation for Economic Co-Operation and Development |
| OEEC | Organization for European Economic Cooperation |
| ONERA | Office National D'Etudes Et De Recherches Aerospatiales |
| PUDDC | Centre for Agricultural Publishing and Documentation |
| RIT | Royal Institute of Technology (Sweden) |
| SCANDOC | Scandinavian Documentation Center |
| SDI | Selective Dissemination of Information |
| SINFDOK | Swedish Council for Scientific Information and Documentation |
| STISEC | Australian National Scientific and Technical Information Authority |
| TRC | Technical Reports Center (U. K.) |
| TURDOK | Turkish Scientific and Technical Documentation Centre |
| UIA | Union of International Associations |
| UKCIS | United Kingdom Chemical Information Service |
| UNDP | United Nations Development Program |
| UNESCO | United Nations Educational, Scientific and Cultural Organization |
| UNIDO | United Nations Industrial Development Organization |
| UNITAR | United Nations Institute for Training and Research |
| USAEC | United States Atomic Energy Commission |
| VTT | Technical Research Centre of Finland |
| WAITRO | World Association of Industrial and Technological Research Organizations |
| WHO | World Health Organization |
| WIPO | World Intellectual Property Organization |
| WMO | World Meteorological Organization |
| ZDOK | Dokumentationszentrum Fur Informationwissenschaften |
| ZLDI | Zentralstelle Für Luft-Und Ramfahrtdokumentation Und-Information |

# APPENDIX 2A
# INDEX TO THE LIST OF WORLDWIDE INFORMATION CENTERS

| REFERENCE CODE | SUBJECT | COUNTRY CODE |
|---|---|---|
| 1 | Acoustics | U. K. IX |
| 2 | Aerodynamics | Israel I; Italy I; Sweden I; U. K. II |
| 3 | Aeroelasticity | Israel I |
| 4 | Aeronautics | Canada V; Japan I, II; Sweden I; U. K. IV |
| 5 | Aerospace | Germany II; Japan II; U. K. V |
| 6 | Aircraft Design | Israel I |
| 7 | Aluminum | France I |
| 8 | Biology | Canada I, VI, VII; South Africa I; Sweden III; Turkey V; U. K. XI |
| 9 | Ceramics | France III |
| 10 | Chemical Engineering | India I; Korea I |
| 11 | Chemistry | Canada I, VI; Denmark I, II; Germany I, III, V; South Africa I; Spain I; Sweden III; U. K. XIV |
| 12 | Civil Engineering | Austria II; Sweden II, V |
| 13 | Communications | Canada III, V |
| 14 | Crystallography | U. K. X, XVI |
| 15 | Economics | France V; India I; Turkey IV; U. K. XII |
| 16 | Electrical Engineering | Korea I |
| 17 | Electronics | Denmark I; New Zealand I; Sweden III; Turkey I |
| 18 | Engineering | Canada VI, VII: Korea I; Netherlands I, II, IV; New Zealand I; South Africa I; Spain I; Sweden I; Turkey V |
| 19 | Entymology | Canada II |
| 20 | Ergonomics | U. K. VI |
| 21 | Flight Dynamics | Israel I |
| 22 | Fluid Dynamics | Belgium II; U. K. I, IX |
| 23 | Gas Phase Reactions | U. K. VIII |
| 24 | Geology | Sweden II; Turkey V |
| 25 | Geomechanics | U. K. VII |
| 26 | Glass | France III |
| 27 | Heat Transfer | Israel I; U. K. I |

## APPENDIX 2A CONTINUED

| | | |
|---|---|---|
| 28 | Human Factors | U. K. VI, IX |
| 29 | Information Sciences | Canada III; Chile I; New Zealand II |
| 30 | Instrumentation | Sweden I |
| 31 | Mass Transfer | Israel I |
| 32 | Materials | Sweden III; U. K. XV |
| 33 | Mathematics | Germany V; Japan I; Netherlands II; New Zealand I; Portugal I; Turkey I |
| 34 | Mechanical Engineering | Japan I; Turkey II |
| 35 | Metallurgy | Denmark I; France I; New Zealand I; Spain I; Turkey I |
| 36 | Meteorology | Canada V; U. K. X |
| 37 | Military Defense | Australia I; Italy II; U. K. V |
| 38 | Mineralology | U. K. X |
| 39 | Natural Sciences | Canada II, VI |
| 40 | Noise | U. K. IX |
| 41 | Nuclear Engineering | Luxemburg I; Sweden III; Turkey I |
| 42 | Nuclear Physics | Austria I; Turkey I |
| 43 | Nuclear Reactions | France II; U. K. XIII |
| 44 | Oceanography | Italy II; New Zealand I |
| 45 | Operations Research | India I; Italy II |
| 46 | Pesticides | Canada II |
| 47 | Physics | Canada I; Denmark I; Germany IV, V; Netherlands I, II; Spain I; Sweden III; Turkey V; U. K. XIII |
| 48 | Polymers | U. K. XII |
| 49 | Productivity | Denmark III; France V; Turkey IV |
| 50 | Reactor Engineering | Austria I; Denmark I |
| 51 | Science | Australia I, II; Austria I, III; Belgium I; Bolivia I; Canada IV; Chile I; China I; Finland I; India I; Korea I; Netherlands III, IV; New Zealand II; Norway I; South Africa I; Spain I; Sweden IV; Switzerland I; Thailand I; Turkey III, IV; U. K. III, XI, XII |
| 52 | Spectroscopy | U. K. XI |
| 53 | Structures | Sweden I; U. K. IX, XV |

APPENDIX 2A CONTINUED

| | | |
|---|---|---|
| 54 | Technology | Australia I, II; Austria III; Belgium I; Bolivia I; Canada IV; China I; Colombia I; Denmark II, III; Finland I, II; France V; Germany V; India I; Netherlands I, III, New Zealand II; Norway I; Spain I; Sweden IV; Switzerland I; Thailand I; Turkey III, V; U. K. III, IV, XI, XII |
| 55 | Telecommunications | Canada III |
| 56 | Textiles | France IV; U. K. XII |
| 57 | Traffic Engineering | Austria II; Sweden II |
| 58 | Transportation | Portugal I |
| 59 | Underwater Acoustics | Italy II; New Zealand I |
| 60 | Vibration | U. K. IX |

# APPENDIX 2 B
# A LIST OF WORLDWIDE INFORMATION CENTERS

**AUSTRALIA** **Country Code: I** **Reference Code: 37, 51, 54**

**Australian Department of Supply Library**
**Constitution Avenue**
**Canberra, Australia Alt 2600**

**Telephone: 062-48211**
**Cable/TWX: SUPDEPCANBERRA**
**Director: Mr. H. J. Zwillenberr**

Collection: science, technology (defense-related). Holdings: 50,000 bks; 2,500 journal subscriptions; 200,000 report materials; 50,000 microfiche; 10,000 full-size internally generated reports/yr; 20,000 full-size externally generated reports/yr. Primary language: English. Holdings obtained from NTIS, world defense agencies.

Retrieval: ADSATIS automated cataloging/indexing system; computerized retrieval, with NTIS & COMPENDEX textprocessing; ADSATIS data base descriptor matching.

Publications:

USER Availability: Services restricted to Australian defense community.

**AUSTRALIA** **Country Code: II** **Reference Code: 51, 54**

**CSIRO Central Library & Information Service**
**314 Albert Street**
**East Melbourne. VIC 3002, Australia**

**Telephone: 03 419 1333**
**Cable/TWX: Coresearch, Melbourne**
**Director Mr. C. Garrow**

Collection: science. Holdings: numerous full-size externally generated reports; numerous microfilm; 120,000 bks; 6,000 journal subscriptions; 11,600 CSIRO translations; 27,000 serials. Primary language: English.

Retrieval: Conventional cataloging, Anglo-American rules, LC subject headings; computerized retrieval, CSIRO index, CA Condensates, INSPEC, BA Previews

Publications: numerous.

User Availability: Write, telex, or telephone for reference, interlibrary loan, sci-tech info services, including SDI current awareness. Most service free, except microfilming & photocopying; charge for SDI. Service delivery: 1 week. Contact for services: Mr. C Garrow, Manager, Information Service; P. Dawe, Chief Librarian.

**AUSTRIA** **Country Code: I** **Reference Code: 42, 50, 51**

**International Atomic Energy Agency (IAEA)**
**P. O. Box 590**
**A-1011, Vienna, Austria**

**Telephone: 52 45 11**
**Cable/TWX: Inatom**
**Director: Mr. R. R. Dickison**

Collection: science, nuclear physics, reactor engineering. Holdings: 15,00 bks; 1,450 journal subscriptions; 20,000 bound journals; 200 patents; 520 films; 40,000 full-size externally generated reports; 120,000 microfiche. Primary language: English. Holdings obtained from Atomic Energy Commissions in member states.

Retrieval: conventional cataloging, UDC; computerized retrieval.

Publications: Accessions List; Serials Holdings; Film Catalog

User Availability: Write, phone, or telex for services; loan & reproduction services; charge of 2As. per photocopy. Service delivery: 2-3 days. Contact for services: Mr. R. R. Dickison, Chief Officer, Library.

## APPENDIX 2B

## A LIST OF WORLDWIDE INFORMATON CENTERS

**AUSTRIA** **Country Code: II** **Reference Code: 12, 57**

**Kuratorium Fuer Verkehrssicherheit**
**1031 Delzeltgasse 3**
**Vienna, Austria**

**Telephone:** **73 15 71**
**Cable/TWX:** **01/3122**
**Director:**

Collection: traffic engineering; road evaluation. Holdings: 50,000 full-size reports; 40 journal subscriptions. Primary language: German, English. Holdings obtained from NTIS, HRB, APA, etc.

Retrieval: conventional indexing/cataloging system, 'SELECTACARD' system with 300 keywords; manual retrieval, using IRRD Thesaurus

Publications: numerous scientific treatises; booklet series "Kleine Fachbuchrgihg"

User Availability: write, phone, or telex for borrowing and photocopy services; free. service delivery: varies with requests. Contact for services: Central Library

**AUSTRIA** **Country Code: III** **Reference Code: 51, 54**

**Library of the University of Technology**
**Karlsplatz 13**
**Vienna IV, Austria**

**Telephone:**
**Cable/TWX:**
**Director:** **Dr. Walter Ritzer**

Collection: science, technology. Holdings: 300,000 bks; 100,000 periodical titles.

Retrieval:

Publications: numerous bibliographies; Accessions List

User Availability: Write or phone for literature searches, compilation of bibliographies, translations. Contact for services: Dr. Walter Ritzer, Director

**BELGIUM** **Country Code: I** **Reference Code: 51, 54**

**Centre National de Documentation**
**Scientifique et Technique (CNDST)**
**Boulevard de 1'Empereur 4**
**B-1000 Brussels, Belgium**

**Telephone:** **02/13.61.80**
**Cable/TWX:** **Telex: 21157 Bib reg br**
**Director:** **Dr. A. Cocky**

Collection: science, technology. Holdings: 3,500,000 bks; 28,000 journal subscriptions; unspecified numbers of bound journals, specs (norms), drawings, translations, magnetic tapes, full-size internally- & externally-generated reports. Primary language: All Holdings obtained from CAC, INSPEC, COMPENDEX, etc.

Retrieval: conventional cataloging; automated retrieval using CAC, Engineering Joint Society, & other classed catalogs (COSATI). Computerized in function of data bases.

Publications: Annual Report (with description of bibliographic searches); Special Bibliographies.

User Availability: write, phone, or telex for services; translation & photocopies. Contact for services: Dr. A. Cockx, Director

## APPENDIX 2 B
## A LIST OF WORLDWIDE INFORMATION CENTERS

**BELGIUM** **Country Code: II** **Reference Code: 22**

**Von Karman Institute for Fluid Dynamics (VKI)**
**VKI Library**
**Chaussee de Waterloo, 72**
**B-1640 Rhode Saint Genese, Belgium**

**Telephone: (02)358.19.0**
**Cable TWX: TRANCEXAERO**
**Director: Mrs. N. V. Toubeau**

Collection: fluid dynamics, Holdings: 250 full-size internally generated reports; 55,000 full-size externally generated reports; 1,900 bks; 60 journal subscriptions. Primary language: English. Holdings obtained from NASA, ARC, NPL, Cranfield, DFVLR, AGARD, RAE, ONERA, UTIAS, NLR.

Retrieval: conventional cataloging/indexing system, based on NASA; manual retrieval

Publications: numerous internal technical notes, memoranda; Lecture Series

User Availability: Write to librarian for list of publications. Charge for lecture series notes; other publications free. Service delivery: normally sent by return. Contact for services: Mrs. N. V. Toubeau, Librarian

**BOLIVIA** **Country Code: I** **Reference Code: 51, 54**

**Centro Nacional De Documentacion Cientifica**
**Y Tecnologica -- Universidad Mayor De San Andres**
**Plaza del Obelisco**
**La Paz, Bolivia**

**Telephone: 50555-50333**
**Cable/TWX: Casilla 3283**
**Director: Dr. Hugo Loaiza Teran**

Collection:
science, technology. Holdings: 1,000 microfiche; 400 bks; 250 journal subscriptions; 60 specs (norms); 50 translations; 30 microfilms. Primary language: English. Holdings obtained from FID, UNESCO, BID, OMS.

Retrieval: conventional cataloging/indexing system; manual retrieval.

Publications: Numerous.

User Availability: Fill formularies corresponding to services requested; reprographic, translation, and bibliographic services. Charge of $1 per page translated; $1 per foot of microfilm; $0.15 each photocopy. Service delivery: 1-week 1-month. Contact for services:
Mr. Javier Vasquez
(Bibliography); Mr. Miguel Aramayo (Reprography); Ms. Susana Aloisio (Translations).

**CANADA** **Country Code: I** **Reference Code: 8, 11, 47**

**British Columbia Research Council**
**3650 Wesbrook Crescent**
**Vancouver B.C., V6T 1W5, Canada**

**Telephone: (604) 224-4331**
**Cable/TWX: RESEARCH BC Telex: 04-507748**
**Director: Dr. P. C. Trussell**

Collection: applied biology, applied physics, applied chemistry. Holdings: 200 microfiche; 8,000 bks; 400 journal subscriptions; 4,000 bound journals; 200 specs. Primary language: English

Retrieval: conventional cataloging/indexing system, Library of Congress; computerized retrieval with subscription to CAN/SDI service

Publications: annual reports; guidelines to industrial progress

User Availability: services available to industry upon request; free reference service. Charge for extensive literature searches. Service delivery: in one week. Contact for services: various staff members assigned to specific subjects

## APPENDIX 2B
## A LIST OF WORLDWIDE INFORMATION CENTERS

**CANADA** **Country Code: II** **Reference Code: 19, 39, 46**

**Canada, Department of Agriculture**
**CDA Library**
**Sir John Carling Building**
**Ottawa, Ontario, Canada K1A OC5**

**Telephone:** (613) 994-9651; 994-9652
**Cable/TWX:** AGRICOTT/Biblio Telex: 053-3283
**Director:** Mrs. M. N. Reynolds

Collection: entymology; plant research; pesticides; natural sciences. Holdings: 100,000 bks; 4,000 journal subscriptions; 50,000 bound volumes; 2,400 translations. Primary language: English, French. Holdings obtained from universities, government agencies, etc.

Retrieval: automated indexing/cataloging system; Dewey Decimal; SDI profiles prepared for CAN/SDI, CAN/OLE, & other data bases.

Publications: List of CDA Publications, 1867 to Date; Monthly List of Selected Acquisitions In the CDA Library; List of Serials Held By the CDA Libraries.

User Avilability: Telephone, write, or signal, preferably through requester's library; all reasonable services provided to outsiders. Contact for services: Mrs. M. N. Reynolds, Director of Libraries; Mr. William P. Dagger, Chief Librarian HQ Library

**CANADA** **Country Code: III** **Reference Code: 13, 29, 55**

**Canada, Department of Communications**
**Information Retrieval Services Branch**
**100 Metcalfe Street, Room 321**
**Ottawa, Ontario Canada K1A OC8**

**Telephone:** (613) 996-7328; 992-8504
**Cable/TWX:** 0533342
**Director:** vacant

Collection: telecommunications, communications, information retrieval. Holdings: 500 full-size internally generated report; 8,000 full-size externally generated reports; 1,500 microfiche; 8,000 bks; 600 journal subscriptions; 12 translations (planned increase). Primary language: English. Holdings obtained from ITU, FCC, NTIS, ERIC.

Retrieval: automated cataloging/indexing system; 1973 & 1974 accessions coded for on-line access.

Publications: none

User Availability: telephone beforehand; outsiders may use center by appointment; interlibrary loans; free. Contact for services: Library or Information Retrieval System Office.

**CANADA** **Country Code: IV** **Reference Code: 51, 54**

**Information Canada**
**Canadian Government Printing Bureau**
**45 Sacred Heart Boulevard**
**Hull, Quebec, Canada K1A OS7**

**Telephone:** 997-2576
**Cable/TWX:**
**Director:** Mr. A.W.O. Blouin

Collection: Canadian government publications (general). Holdings: 75,000 full-size internally-generated reports; 125,000 bks; 200 journal subscriptions; 100 bound journals. Primary language: English. Holdings obtained from Canadian government departments

Retrieval: conventional cataloging/indexing; original system of classification; manual retrieval.

Publications: Daily Checklist of Government Publications; Special List of Government Publications; Monthly Catalogue of Canadian Government Publications.

User Availability: request borrowing services through Library by letter or phone; interlibrary loans; document sales. Free. Service delivery: within 2 weeks. Contact for services: Mr. A. W. O. Blouin, Chief Librarian.

# APPENDIX 2B

# A LIST OF WORLDWIDE INFORMATION CENTERS

CANADA Country Code: V Reference Code: 4,13, 36

**International Civil Aviation Organization**
**Library**
**1080 University Street**
**Montreal 101, P. Que., Canada**

**Telephone: 866-2551**
**Cable/TWX: ICAO Montreal**
**Director: Mrs. F. Ismail**

Collection: aeronautics, air transport, meteorology, communication. Holdings: 16,800 bks, 160 journal subscriptions, 3,100 bound journals; 12,000 reports; 10,000 pamphlets. Primary language: English. Holdings obtained from commercial agents, government departments, international organizations, research centers.

Retrieval: conventional cataloging/indexing system; Dewey Decimal modified by UDC; manual retrieval through card catalogs.

Publications: Library Information; Recent Accessions; List of Selected Articles On ICAO and Civil Aviation; Index of ICAO Publications.

User Availability: Write, phone or telex; interlibrary loans, use of collection in-house, reference service for specific research projects. Free. Contact for services: Reference personnel.

CANADA Country Code: VI **Reference Code: 8, 11, 18, 39**

**Research Council of Alberta**
**Information Systems**
**11315-87 Avenue**
**Edmonton, Alberta, Canada**

**Telephone: (403) 433-6421**
**Cable/TWX**
**Director: Mr. A. FitzPatrick**

Collection: computerized information services. Holdings: CAIN, U. S. Dept. of Agriculture holdings. Primary language: English. Holdings (data bases) obtained from NSL, U. of C., Lockheed, SDC.

Retrieval: computerized.

Publications: AIRA-ASIS Newsletter

User Avilability: Registration fee of $10; past that subscriber billed for individual services. Information retrieval service provided, with follow up document service in which original document is provided. Charges vary with services. Service delivery: from 5 minutes (on-line search) to 2 weeks (off-line) batch search. Contact for services: Ms. Mary Fletcher, Information Systems.

CANADA Country Code: VII **Reference Code: 8, 18**

**University of Calgary**
**Information Systems, Library, UNICIS**
**2920-24 Avenue, N.E.**
**Calgary, Alberta, Canada T2N 1N4**

**Telephone: (403) 234-6221**
**Cable/TWX**
**Director: O.Standera**

Collection: computerized information services. Holdings: machine-readable data bases for COMPENDEX, ERIC (RIE & CIJE), and MARC II; on-line services for MEDLINE. Other on-line services being implemented, including INFORM, CAC, INSPEC, BA.

Retrieval: computerized; IBM's TEXT-PAC with SDI (current awareness), retrospective searching, indexes. Amended by Univ. of Calgary.

Publications; numerous computerized information services.

User Availability: subscription to all services for a fee.

## APPENDIX 2B
## A LIST OF WORLDWIDE INFORMATION CENTERS

**CHILE** **Country Code: I** **Reference Code: 29, 51**

**Centro Nacional de Informacion y Documentacion**
**Canada No. 308 - Casilla 297-V**
**Santiago, Chile**

**Telephone:** 744537, Anexo 24
**Cable/TWX:** CONICYT-CENID
**Director:** Ms. Anna Maria Prat.

Collection: science, information science. Collection: 2,122 bks; 42 journal subscriptions; 2,000 documents on information sciences. Primary language: Spanish, English

Retrieval: manual retrieval, Uniterm: conventional cataloging/indexing system, Anglo American rules; KWOC index

Publications: Notas Informativas CENID; News About Information Systems Centers.

User Availability: Write for reprographic and referral services; charges depending on type of service. Service delivery: 2-3 weeks. Contact for services: Ms. Anna Maria Prat., CENID Director

**CHINA, REPUBLIC OF** **Country Code: I** **Refernce Code: 51, 54**

**Scientific Documentation Centre**
**128-1 Yen Chiu Road, Section 2**
**Nankang, Taipei, Taiwan**
**Republic of China**

**Telephone:** 756403, 754124-6, 760762
**Cable/TWX:**
**Director:** Mr. Tseng-Chee Shen

Collection: science, technology. Holdings: 6,000 full-size internally generated reports; 22,284 full-size externally generated reports; 550 bks (English); 400 bks (Chinese & Japanese); 330 foreign journal subscriptions; Chinese patents nos. 10507-13687; 146 microfilm. Primary language: Chinese, English

Retrieval: conventional cataloging/indexing system; manual retrieval, planned use of computers for information processing.

Publications: numerous

User Availability: Free service for reference, translation, coordination services; charge for photocopies. Service delivery: immediate to 3 days. Contact for services: Scientific Documentation Centre, Second Division

**COLOMBIA** **Country Code: I** **Reference Code: 54**

**Institute for Technological Research**
**Industrial Information Service**
**Avenida 30 No. 52-A-77**
**Bogota, D. E., Colombia**

**Telephone:** 350066
**Cable/TWX:** TECHNOLOGICO
**Director:** Mr. Jorge A. Beltran

Collection: technology. Holdings: 1,300 full-size internally generated reports; 500 microfilm; 5,100 bks; 700 journal subscriptions; 100 bound journals; 272 patents; 906 specs (norms); 20,000 booklets. Primary language: English.

Retrieval: conventional cataloging/indexing system, Dewey Decimal; manual retrieval

Publications: Tecnologica

User Availability: Write for services, free. Contact for services: Ms Bertha Mesa, Librarian

# APPENDIX 2B
# A LIST OF WORLDWIDE INFORMATION CENTERS

**DENMARK** **Country Code: I** **Reference Code: 11, 17, 35, 47, 50**

**Atomic Energy Research Establishment, Risø**
**Library**
**Riso, pr. Roskilde, Denmark**

**Telephone: 03 35 51 01**
**Cable/TWX: 43116 Risatom dk**
**Director: Ms. Eva Pedersen**

Collection: chemistry, electronics, metallurgy, physics, reactor engineering. Holdings: 200,000 full-size externally generated reports; 90,000 microfiche; 50,000 bks; 2,000 journal subscriptions. Primary language: English. Holdings obtained from atomic energy centers worldwide and USAEC.

Retrieval: automated retrieval; subscription to computerized SDI services, e.g., NSA, CA, CAC, ENDS (Euratom).

Publications: Risø Reports; Risø M-Report.

User Availability: loan and reference services, photocopies, SDI; free. Service delivery: 1 day. Contact for services: Reference Department, Library.

**DENMARK** **Country Code: II** **Reference Code: 11, 54**

**Danmarks Tekniske Bibliotek**
**National Technological Library of Denmark**
**Anker Engelunds Vej 1**
**DK2800 Lyngby, Denmark**

**Telephone: (01) 88 30 88**
**Cable/TWX: 15048**
**Director: Ms. Helge J. Skov**

Collection: 350,434 bks; 7,310 journal subscriptions; 100,000 full-size externally generated reports. Primary language: English.

Retrieval: conventional cataloging/indexing system, UDC; Documentation Dept. uses computerized system based on Teletext.

Publications: Numerous.

User Availability: Write, phone, or telex for services; various data bases, e.g., Chem Abstracts, Condensates, Chemical Titles, Food Science & Technology Abstracts. Charges vary. Service delivery: Immediate. Contact for services: Department Head.

**DENMARK** **Country Code: III** **Reference Code: 49, 54**

**Dansk Teknisk Oplysningstjeneste (DTO)**
**Danish Technical Information Service**
**Ørnevej 30**
**DK-2400 Copenhagen, Denmark**

**Telephone: (01) 10 91 95**
**Cable/TWX: DANTEKOP**
**Director: Mr. Kjeld Klintoe**

Collection: marketing institution: technology. Primary language: English. Holdings obtained from NTIS, GPO, Stanford, Arthus D. Little, NRC (Canada).

Retrieval: conventional cataloging/indexing system; manual retrieval

Publications: numerous.

User Availability: established Danish companies may obtain liaison service, info. services; provision of documents, info. analysis, technology & marketing reports. For services requested charge of $30/hr. Contact for services: Mr. Max Meedom.

# APPENDIX 2B
# A LIST OF WORLDWIDE INFORMATION CENTERS

**FINLAND** **Country Code I** **Reference Code: 51, 54**

**Helsinki University of Technology**
**Library**
**SF 02150 Otaniemi, Finland**

**Telephone: 90-461 355**
**Cable/TWX: 12-1591 sf**
**Director: Elin Tornudd**

Collection: science, technology. Holdings: 100,000 full-size externally generated reports; 200,000 microfiche; 1,000 microfilm rolls; 100,000 bks; 5,400 journal subscriptions; 200,000 bound journals; 50,000 patents; 25,000 specs (norms); 180 magnetic tapes. Primary language: English. Holdings obtained from BL, NTIS.

Retrieval: conventional cataloging, with planned automation; on-line inter-active system for retrospective searches of INIS.

Publications: Research Papers (irregular report series); Occassional Papers (irregular series); numerous institutional serial publications, dissertations, etc.

User Availability: By letter, telex, or telephone request interlibrary loans, reprography, microcopy enlargement, literature searches, language studio service, reference services; most services free, except for computer-based info. service, major literature searches, photocopies & enlargements. Service delivery: Immediate. Contact for services: Mrs. Stina Niskanen, Head, Tech. Info. Dept.; Ms. Leena Uuttu, Head, Loans & Tech. Services Dept.

**FINLAND** **Country Code: II** **Reference Code: 54**

**Technical Research centre of Finland**
**Lonnrotinkatu 37**
**00180 Helsinki 18, Finland**

**Telephone: 648931**
**Calbe/TWX: 12-1217**
**Director: Mrs. Eva Wartiovaara**

Collection: Technology. Holdings: 87,000 bk Titles and journals; 1,050 journal subscriptions. Primary language: English, German, Finnish.

Retrieval: conventional cataloging/indexing system, UDC; manual retrieval

Publications: Reports (60/yr); Building Technology & Community Development (15/yr); Materials & Processing Technology (15/yr); Electrical & Nuclear Technology (15/yr)

User Availability: Telephone or visit for reference service, literature searches. Literature search charges by time used. Photocopy charges @ 50 pennies/page. ADP-based SDI service charges @ 300-400 Fmk/yr. Service delivery: 1-2 weeks Contact for services: Mrs. Riitta Heikinheimo, Info Scientist; Mrs. Kristiina Erkko, Librarian

**FRANCE** **Country Code: I** **Reference Code: 7, 35**

**Aluminum Pechiney**
**Service Documentation**
**Centre de Recherches**
**B.P. 24-38340-Voreppe, France**

**Telephone: (76) 87-89-61**
**Cable/TWX: 32783**
**Director: Mr. P. Marcel**

Collection: aluminum. Holdings: 5,000 full size externally generated reports; 1,000 microfiche; 30,000 mircofilms; 5,000 bks, 300 journal subscriptions, 200 bound journals, 4,000 patents, numerous specs (norms). Primary language: French, English. Holdings obtained from World Aluminum Abstracts, Derwent, C.N.R.S.

Retrieval: cataloging/indexing system adaptation of C.D.U. system; automated thesaurus; retrieval using FILMOREX automated system, IRMS system

Publications: Numerous (internal)

User Availability: Write for services. Contact for services: Mr. P. Marcel, Chef du Service Documentation.

# APPENDIX 2B
# A LIST OF WORLDWIDE INFORMATION CENTERS

**FRANCE** **Country Code: II** **Reference Code: 43**

**Centre de Compilation de Donnees Neutroniques (CCDN)**
**Neutron Data Compilation Centre**
**BP 9, F-91190 Gif-sur-Yvette, France**

**Telephone:** 941 3965
**Cable/TWX:** CEDODON 69920F
**Director:** Dr. F. H. Froehner

Collection: nuclear reactions. Holdings: 2,000,000 measured data points; 600,000 evaluated data records; 102,000 key-worded bibliographic records referring to 48,000 neutron-physics publications; 1,400 official requests for neutron data measurements. Primary language: English. Holdings obtained from labs in CCDN service area, NNCSC (U.S., Canada), CJD (U.S.S.R.), & CINDA Centres.

Retrieval: CINDA (Computer Index to Automated Data); NEUDADA (Neutron Data Under Direct Access); both are disc-based direct-access systems.

Publications: CCDN Newsletter.

User Availability: Contact regional center for retrieval, plots of data, & literature searches. Free. Service delivery: 3 days. Contact for services: Dr. N. Tubbs (CINDA); Dr. A. Schette & Dr. K. Okamoto (experimental data).

**FRANCE** **Country Code: III** **Reference Code: 9, 26**

**Institut Du Verre**
**Service Documentation**
**34 Rue Michel-Ange**
**75016 Paris, France**

**Telephone:** 647-60-93
**Cable/TWX:** INSTITUVEH, Paris
**Director:** Miss Sellin

Collection: ceramics, glass. Holdings: 500 microfiche; 50 microfilms; 2,000 bks; 250 journal subscriptions; 8,000 patents; 4,000 translations. Primary language: French, English, Russian.

Retrieval: conventional cataloging/indexing system; manual retrieval.

Publications: Verres Et Refractaires; numerous others.

User Availability: Write for reprography, translations, bibliographic compilations. Photocopy charge of 2F per page. Charges vary for other services. Service delivery; 8 days-1 month. Contact for services;: Mlle. Sellin

**FRANCE** **Country Code: IV** **Reference Code: 56**

**Institut Textile De France**
**35 Rue des Abondances**
**92100 Boulogne, France**

**Telephone:** 825 18 90
**Cable/TWX:**
**Director:** Mr. J. M. Ducrot

Collection: textiles. Holdings: 50,00 full-size internally generated reports; 9,000 bks; 680 journal subscriptions; numerous patents, specs (norms), translations. Primary language: French, English, German, Spanish.

Retrieval: Automated retrieval and cataloging/indexing systems.

Publications: Numerous.

User Availability: Write or phone for services; translations, retrospective searches, SDI services; charges vary. Service delivery: 2 days. Contact for services: Mr. J. M. Ducrot, Director of Documentation.

## APPENDIX 2B
## A LIST OF WORLDWIDE INFORMATION CENTERS

**FRANCE** **Country Code: V** **Reference Code: 15, 49, 54**

**Organisation for Economic Co-operation**
**and Development (OECD), Library**
**2 Rue Andre Pascal**
**75775 Paris Cedex 16, France**

**Telephone:** 524 82 00
**Cable/TWX:** DEVELOPECONOMIE PARIS
**Director:** Mr. Peter Judge

Collection: economics, technology. Holdings: 62,000 bks; 4,000 journals. Primary language: English, French

Retrieval: conventional cataloging/indexing systems; manual retrieval.

Publications: Numerous.

User Availability: Library open to visitors; restricted lending of books. Users may request catalog of OECD publications, free. Contact for services; Mr. Peter Judge, Head, Section for Scientific & Technical Information.

**FRANCE** **Country Code: VI** **Reference Code: 42, 51, 54**

**Centre de Documentation du Centre National**
**de la Recherche Scientifique (CNRS)**
**75971 Paris CEDEX 20, France**

**Telephone:** 636-62-34
**Cable/TWX:** CNRSDOC 22880F
**Director:** Mr. Jacques-Henri d'Olier

Collection: nuclear engineering, science, technology. Holdings: 40,000 microfiche; 35,000 bks; 15,000 journal subscriptions; 43,000 theses; 15,000 congress proceedings. Primary language: English.

Retrieval: automated PASCAL system & PASCAL III for documentation on magnetic tapes; computerized SDI on CRISTAL and VIRA; manual retrospective searches.

Publications: *Bulletin Signaletique; Bulletin Des Traductions.*

User Availability: No restrictions for Bulletin Signaletique annual subscription, SDI on profiles, PASCAL tapes, translations, reproduction, and retrospective searches. Charges vary. Service delivery: varies. Contact for services: Miss Yvonne Salle, Head of Service Promotion and Diffusion.

**GERMANY, FEDERAL REPUBLIC OF** **Country Code: I** **Reference Code: 11**

**Chemie-Information und Dokumentation Berlin**
**1000 Berlin 12, Steinplatz 2**
**Federal Republic of Germany**

**Telephone:** 31 02 81
**Cable/TWX:**
**Director:** Dr. Christian Weiske

Collection: abstracting, indexing & information service in chemistry

Retrieval: conventional cataloging/indexing system; computerized retrieval.

Publications: Trivialnamenkartei; Chemischer Informationsdienst (abstracting service).

User Availability: Write to center requesting service; subscribe to Chemischer Informationsdienst. SDI & retrospective searches available from CA-Condensates and CBAC (Chemical Biological Activities). Free 6 month test period; thereafter, fee of DM 480 per profile & year; DM 0.10 price per hit. Service delivery: 2 weeks. Contact for services: Dr. Christian Weiske, Editor-In-Chief.

## APPENDIX 2B
## A LIST OF WORLDWIDE INFORMATION CENTERS

**GERMANY, FEDERAL REPUBLIC OF** Country Code: II Reference Code: 5

Deutsche Forschungs-und Versuchsanstalt für
Luft-und Raumfahrt e.V. (DFVLR)
Zentralstelle für Luft-und Raumfahrtdokumentation
und-Information (ZLDI)
8 München 86 Postfach 860880, Germany

Telephone: 089/47-40-28
Cable/TWX: 05/22324
Director: Dr. v. Consbruch

Collection: Aerospace. Holdings: 1,250,000 million full-size externally-generated reports; 500,000 aerospace science reports; conference papers; proceedings; preprints Primary language: German. Holdings obtained from NSA, STAR, IAA, GRDR, ESA/NASA, Engineering Index; Metals Abstracts.

Retrieval: RECON; connected to information network of Space Documentation Service of ESA; bibliographic data, notes of content and key words about 1,250,000.

Publications: none.

User Availability: available to all users in Federal Republic of Germany; outsiders may use for SDI; retrospective literature searches.

**GERMANY, FEDERAL REPUBLIC OF** Country Code: III Reference Code: 11

IDC Internationale Dokumentations
Gessellschaft Für Chemie
Hamburger Allee 26-28
D-6 Frankfurt, Germany 90

Telephone: 79 7486
Cable/TWX:
Director: Dr. Arthur Kolb

Collection: chemistry. Holdings: 300,000 publications; 150,000 patents. Primary language: German, English.

Retrieval: computerized.

Publications: none.

User Availability: Write for computerized searches, abstracts and patents. Charges vary. Service delivery: 2 weeks. Contact for services: Dr. Arthur Kolb.

**GERMANY, FEDERAL REPUBLIC OF** Country Code: IV Reference Code: 47

Physikalische Berichte
i. Hs. c/o Physikalische Technische
Bundesanstalt
D-33, Braunschweig, Bundesallee 100, Germany

Telephone: 592 2278
Cable/TWX: 9 52 822
Director: Dr. Wolfgang Zwirner

Collections: Abstracting service in physics. Primary language: German, English.

Retrieval: computerized literature data bases with bibliographic items, free language descriptors, & classification numbers.

Publications: Physikalische Berichte.

User Availability: Subscribe; written inquiries free. Service delivery: 1 month. Contact for services: Dr. W. Zwirner, Editor-In-Chief.

# APPENDIX 2B
# A LIST OF WORLDWIDE INFORMATION CENTERS

**GERMANY, FEDERAL REPUBLIC OF** **Country Code:** V **Reference Code:** 11, 33, 47, 54

**Technische Informationsbibliothek**
**Welfengarten 1B**
**D-3000 Hanover 1, Germany**

**Telephone:** (0511) 7 62 22 68
**Cable/TWX:** 9 22 168
**Director:** Dr. G. Schlitt

Collection: chemistry, mathematics, physics, technology. Holdings: 500,000 bks; 14,000 journal subscriptions; 300,000 bound journals; 1,500,000 patents; 30,000 translations; 150,000 microfiche; 100,000 full-size externally generated reports. Primary language: German, English, Russian.

Retrieval: conventional cataloging/indexing system; manual retrieval.

Publications: *Deutsche Forshungsberichte* (quarterly); announcement series of Eastern Languages Department.

User Availability: Write for interlibrary loans, photocopies, microfilms, microfiche. Charges by pre-paid requisition forms. Service delivery: 3-4 days. Contact for services: Library.

**INDIA** **Country Code:** I **Reference Code:** 10, 15, 45, 51, 54

**Council Of Scientific & Industrial Research (CSIR)**
**Headquarters Library**
**Room No. 97, CSIR**
**Raji Marg, New Delhi 1, India**

**Telephone:** 383199
**Cable/TWX:**
**Director:** Mrs. R. K. Chhibber

Collection: science, technology, economics, operations research, chemical engineering. Holdings: 7,500 bks; 120 journal subscriptions; 2,000 bound journals; 10,700 patents; Indian standards/specifications (approx. 7,000). Primary language: English.

Retrieval: conventional cataloging/indexing systems, A.L.A.; manual retrieval.

Publications: None.

User Availability: Write or telephone for reference services; free. Contact for services: Mrs. R. K. Chhibber, Librarian.

**ISRAEL** **Country Code:** I **Reference Code:** 2, 3, 6, 21, 27, 31

**Technion-Israel Institute of Technology**
**Aeronautical Engineering Library**
**Haifa, Israel**

**Telephone:**
**Cable/TWX**
**Director:** Mr. David Mendrzycki

Collection: aerodynamics, aerolasticity, flight dynamics, heat transfer, mass transfer, aircraft design. Holdings: 8,000 bks; 200 journal subscriptions; 2,500 bound journals; 33,000 full-size externally generated reports; 200 films. Primary language: English. Holdings obtained from NASA, ARC, AIAA, Cranfield, MIT, ONERA

Retrieval: conventional cataloging/indexing system; manual retrieval.

Publications: T.A.E. Reports (irregular).

User Availability: Services supplied to every reader; lending & current information services free. Service delivery: 2 days. Contact for services: Mr. David Mendrzycki, Chief Librarian.

# APPENDIX 2B
# A LIST OF WORLDWIDE INFORMATION CENTERS

**ITALY** Country Code: I Reference Code: 2

Instituto Di Aerodinamica-Facolta'Di Ingegneria
Universita' Degli Studi Di Napoli
Piazzale V. Tecchio 80-80125 Naples, Italy

Telephone: 619554
Cable/TWX:
Director: Ms. Adriana Rossi Gargiulo

Collection: aerodynamics. Holdings: 205 full-size internally generated reports; 40,000 full-size externally generated reports; 2,000 bks; 110 journal subscriptions; 1,000 bound journals. Primary language: English. Holdings obtained from NASA, AGARD, educational institutions.

Retrieval: conventional indexing/cataloging system, adapted Dewey Decimal system; manual retrieval.

Publications: None.

User Availability: photocopies; in-house consultation of collection; free. Contact for services: Ms. Adriana Rossi Gargiulo, Librarian.

**ITALY** Country Code: II Reference Code: 37, 44, 45, 59

NATO SACLANT Antisubmarine Warfare Research Centre
SACLANTCEN Scientific & Technical Information
Viale San Bartolomeo 400
19026 La Spezia, Italy

Telephone: (187) 503540
Cable/TWX: SACLANTCEN, La Spezia
Director: John P. Bethell

Collection: Underwater acoustics, oceanography, operations research. Holdings: 10,000 full-size externally generated reports; 550 full-size internally generated reports; 3,900 bks; 205 journal subscriptions; 2,300 bound journals. Primary language: English. Holdings obtained from Ministries of Defence of NATO nations, NTIS, British Library, Lending Division (BLL)

Retrieval: conventional cataloging/indexing system, UDC; manual retrieval.

Publications: numerous reports, memoranda, conference proceedings, monographs.

User Availability: Outsiders must obtain NATO security clearance through national channels with "need-to-know"; free services. Service delivery; varies with request. Contact for services: Mr. John P. Bethell, Head Scientific & Technical Info.

**JAPAN** Country Code: I Reference Code: 4, 33, 34

Nagoya University
Dept. of Aeron. Engineering Library
Furo-Cho, Chikuoa—Ku, Nagoya, Japan

Telephone: Nagoya (052), 781-5111
Cable/TWX:
Director: Miss Kazuko Kato

Collection: aeronautical engineering, mechanical engineering, mathematics. Holdings: 36 journal subscriptions; 35 full-size externally generated reports. Primary language: Japanese, English. Holdings obtained from NASA, etc.

Retrieval: conventional cataloging/indexing system; manual retrieval.

Publications: Memoirs of the Faculty of Engineering, Nagoya University.

User Availability: Self-service; photocopies @ 15 yen per page. Contact for services: Miss Kazuko Kato, Secretary.

# APPENDIX 2B
# A LIST OF WORLDWIDE INFORMATION CENTERS

**JAPAN** **Country Code: II** **Reference Code: 4, 5**

National Aerospace Laboratory
Library
1880 Jindaiji machi, Chofu shi
Tokyo, Japan

Telephone: 0422-47-5911
Cable/TWX:
Director: Mr. Masanobu Kawagoe

Collection: aeronautics, aerospace. Holdings: 10,700 bks; 800 journal subscriptions; 10,500 bound journals; 15 patents; 5,000 microfilm; 35,000 full-size externally generated reports; 800 full-size internally generated reports; Primary language: Japanese, English. Hodlings obtained from NASA, ARC, AGARD, DLR, ONERA, NRC, UTLAS, NLR, JPL, FFA, ARL, ICAO, SAE, AIAA, ASME, SAO.

Retrieval: manual cataloging/indexing system, UDC.

Publications: numerous.

User Availability: Identification card or letter of introd. by person in a non-profit agency; interlibrary loans & reference service free. Contact for services. Mr. Masanobu Kawagoe, Chief Librarian.

**KOREA** **Country Code: I** **Reference Code: 10, 16, 18, 51**

Korea Scientific & Technological
Information Center (KORSTIC)
206-9 Cheongryangri-dong
Dongdaimun-ku, Seoul, Korea

Telephone: 96-5051-4
Cable/TWX: KORSTIC, Seoul, Korea
Director: Mr. Doo-hong Kim

Collection: engineering, chemical engineering, electrical engineering, science. Holdings: 2,210 bks; 1,605 journal subscriptions; 31,000 bound journals; 50 translations; 5,167 full-size externally generated reports; 61,300 microfilm; U. S., Japan, France, U. K., & Korean patents. Primary language: English, Japanese, Korean. Holdings obtained from BL, CNRS, John Crerar Library

Retrieval: conventional cataloging/indexing system; manual retrieval.

Publications: numerous.

User Availability: Membership or payment for each service; current awareness, reprography, literature searches, translation, international exchange services. Service delivery: varies for services. Contact for services: Dept. of Service.

**LUXEMBURG** **Country Code: I** **Reference Code: 41**

Commission of the European Communities
European Nuclear Documentation Service (ENDS)
29 Rue Aldringen
Luxemburg

Telephone: 29241
Cable/TWX: EURODOC 752
Director: Dr. C.O. Vernimb

Collection: nuclear engineering & technology. Holdings: 1,500,000 microfiche. Primary language: English. Holdings obtained from Nuclear Science Abstracts, INIS, other abstracting journals.

Retrieval: on-line retrieval for 200,000 in house documents; batch retrieval with total file of 1,500,000 documents.

Publications: Numerous.

User Avilability: Send request form for retrospective literature searches and SDI. Retrospective searches free for Community countries; $50 outside users. SDI costs $25 for Community countries; $50 outside users. Service delivery: 1 week. Contact for services: Dr. C. O. Vernimb.

## APPENDIX 2B
## A LIST OF WORLDWIDE INFORMATION CENTERS

**NETHERLANDS** Country Code: I Reference Code: 18, 47, 54

DSM, Centrale Bibliothek
P. O. Box 18
Geleen, The Netherlands

Telephone: (04494) 9111
Cable/TWX: 56158 DSM NL
Director: Mr. F. J. G. Kwanten

Collection: chemistry, physics, engineering. Holdings: 60,000 bks; 2,000 journal subscriptions; 1,200 bound journals; 1,200 full-size internally generated reports/yr. Primary language: English, Dutch, French, German, Russian.

Retrieval: automated retrieval for journals & reports; conventional retrieval for books.

Publications: internal.

User Availability: Direct questions to Library Technical Univ. at Delft; primarily industrial users; charges for some services. Contact for services: Mr. F. J. G. Kwanten, Head, Library/Documentation/Translation.

**NETHERLANDS** Country Code: II Reference Code: 18, 33, 47

Eindhoven University of Technology
Library
P. O. Box 513, Eindhoven, The Netherlands

Telephone: 040 472223
Cable/TWX: 51163
Director: Dr. P. J. C. A. Pinter

Collection: mathematics, physics, chemistry, engineering, management. Holdings: 1,000 full-size internally generated reports; 290,000 full-size externally generated reports; 1,000 microfiche; 100,000 bks, 3,500 journal subscriptions, 40,000 bound journals, 125,000 norms. Primary language: English

Retrieval: conventional cataloging/indexing system; author and title catalogs arranged and printed by computer.

Publications: internal bulletin

User availability: write for provision of variety of services, mostly free. Small charge for photocopies; major mailing costs are charged. Contact for services: Head of Lending Department.

**NETHERLANDS** Country Code: III Reference Code: 51, 54

European Translations Centre (ETC)
Doelenstraat 101
Delft, The Netherlands

Telephone: 015-142242; 015-142243
Cable/TWX: 31673 ETC NL
Director: Mr. D. van Bergeijk

Collection: science, technology. Holdings: 150,000 full-size externally generated reports; 15,000 microfiche; 35,000 microfilms. Translations published in "difficult" languages, e.g., Russian, Japanese, Polish, Hungarian, Chinese, etc. Primary language: English.

Retrieval: conventional cataloging/indexing systems; manual retrieval.

Publications: Numerous.

User Availability: Write, telex, or telephone for information on locating sci-tech translations from "difficult" languages. Translations free plus small handling fee. Service delivery: 1 day-1 week. Contact for services: Information Officer, etc.

# APPENDIX 2B
# A LIST OF WORLDWIDE INFORMATION CENTERS

NETHERLANDS Country Code: IV Reference Code: 18, 51

**Library of Technological University**
**Doelenstraat 101, P. O. Box 98**
**Delft, The Netherlands**

Telephone: 015-133222
Cable/TWX: BITHDNL
Director: Dr. J. Zandvliet

Collection: engineering, science, social sciences. Holdings: 182,600 microfiche reports, 400 microfilm, 294,000 bks, 6,200 journal subscriptions, 188,000 bound journals, complete collection of Dutch patents, complete collection of Dutch, British, and German standards and incomplete collection of standards from 43 countries dissertations. Primary language: English, Dutch, German, French, and Russian.

Retrieval: conventional cataloging/indexing system with alphabetical author and keyword catalogs; classified subjects and thesis catalogue; manual retrieval system.

Publications: monthly list of acquisitions; annual list of current periodicals.

User availability: Write, phone, or telex for services; free circulation system and reproduction service. Service is daily. Contact for services: Miss A. P. Pieper, Head Service Department.

NETHERLANDS Country Code: V Reference Code: 11

**Royal Netherlands Chemical Society**
**Netherlands Organization For Chemical Information (NOCI)**
**P. O. Box 1766, The Hague, The Netherlands**

Telephone: 070 462509
Director: Dr. Charles L. Citroen

Collection: chemistry. Holdings: five years' *Chemical Abstracts Condensates* on magnetic tapes. Primary language: English Holdings obtained from Chemical Abstracts Service.

Retrieval: computerized retrieval for current awareness and retrospective searching. On-line interactive retrospective search system based on ESRO. in progress.

Publications: None.

User availability: Request; current awareness and retrospective searches; annual subscription about $200. Service delivery: current awareness service every two weeks. Contact for services: Dr. Charles L. Citroen, Director

NEW ZEALAND Country Code: I Reference Code: 17, 18, 33, 35, 44, 59

**Defence Scientific Establishment**
**Library**
**HMNZ Dockyard**
**Auckland 9, New Zealand**

Telephone: 454000, Ext. 702
Cable/TWX:
Director: Miss N. Neilsen

Collection: underwater acoustics, oceanography, metallurgy, engineering, electronics, mathematics. Holdings: 49,600 full-size externally generated reports; 2,199 microfiche; 23,100 microfilms; 2,150 bks; 174 journal subscriptions; 1,775 bound volumes; 130 specs (norms); 1,044 translations. Primary language: English. Holdings obtained from U. K. Min. of Defence, NTIS, Defence Res. Bd. (Canada).

Retrieval: conventional cataloging/indexing systems; manual retrieval

Publications: None.

User Availability: Join a participating library in New Zealand Interloan Scheme, or exchange agreement of published material only. Contact for services: Miss N. Neilsen, Librarian.

# APPENDIX 2B
# A LIST OF WORLDWIDE INFORMATION CENTERS

**NEW ZEALAND** Country Code: II Reference Code: 29, 51, 54

**Department of Scientific and Industrial Research (DSR) Library**
**Private Bag**
**Wellington, New Zealand**

Telephone: 57-959
Cable/TWX: RESEARCH
Director: Mr. Paul Szentirmay

Collection: information science, science, technology. Holdings: 5,000 bks; 2,500 journal subscriptions; 12,000 bound volumes; 900 annual reports; 500 microfiche. Primary language: English.

Retrieval: conventional cataloging/indexing system, UDC; plans for construction of a DSIR Thesaurus for manual indexing.

Publications: Accession List (quarterly); DSIR Documentation (irregular).

User Availability: Write, telex, or telephone for bibliographical, reference, and loan services; free. Service delivery: Immediate. Contact for services: Reference Librarian.

**NORWAY** Country Code: I Reference Code: 51, 54

**University of Trondheim**
**Norwegian Institute of Technology**
**Library, N-7034**
**Trondheim-NTH, Norway**

Telephone: 30100 & 36520
Cable/TWX: NTHB Telex: 55186 nthhb n.
Director: Mr. Knut R. Thalberg

Collection: science, technology, architecture. Holdings: 5,000 full-size internally generated reports; 2,000 microfiche; 300 reels of microfilm; 250,000 bks; 7,980 journal subscriptions; 200,000 bound journals; 800,000 patents; 200,000 specs; 120 translations. Primary language: English.

Retrieval: mechanization of library routines in process; SDI computerized retrieval.

Publications: Numerous reports, subject bibliographies, accession lists.

User Availability: Write, phone or telex. Interlibrary loans made on international book-lending forms; all services available. Charge for retrieval work of more than one hour. Service delivery: usually same day. Contact for services: for SDI, Documentation Dept.; for loan & copying: Lending Dept.

**PORTUGAL** Country Code: I Reference Code: 33, 58

**Directorate General For Land Transport**
**Documentation and Information Centre**
**Avenida 28 de Maio, 40**
**Lisbone 4, Portugal**

Telephone: 767681, 764470, Ext. 210
Cable/TWX: 16597 DGTT P
Director: Mrs. Rebordao

Collection: transportation, mathematics. Holdings: 3,906 bks; 199 journal subscriptions; 72 translations; 497 full-size internally generated reports; 4,546 full-size externally generated publication titles. Primary language: English, French

Retrieval: conventional cataloging/indexing system, UDC: manual retrieval.

Publications: monthly *Bibliographic Bulletin; Transportes* periodical

User Availability: Use of library and requests for bibliographic information to authorized outsiders. Eligibility requires identification or address of inquiries by letter to Directorate General. Services free. Service delivery: immediate. Contact for services: Mrs. Rebordao, Chief Technician

## APPENDIX 2B
## A LIST OF WORLDWIDE INFORMATION CENTERS

**SOUTH AFRICA** Country Code: I Reference Code: 8, 11, 18, 51

South African Selective Dissemination
of Information (SASDI)
Info & Research Service, P. O. Box 395
Pretoria, South Africa

Telephone: 74-6011
Cable/TWX: 3-630
Director: Miss N. M. Lodder

Collection: magnetic tape sources only. Holdings: Chemical Abstracts CONDENSATES, vol. 79; Science Citation Index, Dec. 1973-; Science Abstracts, Jan. 1974-. Primary language: English. Holdings obtained from INSPEC, Chemical Abstracts.

Retrieval: IBM 360/65 computer, Natl. Res. Council of Canada programs. Plans to add Biological Abstracts & Engineering Index on magnetic tapes in 1974.

Publications: none.

User Availability: Charges for computerized current awareness services; services include "profile preparation". Service delivery: depending on profile, 2-3 weeks. Contact for services: Mr. A. G. Brunt; Mr. N. Spicer.

**SPAIN** Country Code: I Reference Code: 11, 18, 35, 47, 51, 54

Centro de Informacion y Documentacion (CID)
Joaquin Costa, 22
Madrid 6, Spain

Telephone: 261 48 08
Cable/TWX: 22628 cidmd e
Director: Dr. Jose Ramon Perez Alvarez-Ossorio

Collection: chemistry, engineering, science, technology. Holdings: 17,326 bks; 1,945 journal subscriptions; 3,100 translations. Primary language: English, German, Spanish.

Retrieval: computerized; 2,700 primary national & foreign journals used to produce abstracts; input on 9 track magnetic tape.

Publications: Numerous bibliographies, reports.

User Availability: Write for SDI, retrospective searches. Charges vary. Service delivery: 4-5 days. Contact for services: CID Secretary.

**SWEDEN** Country Code: I Reference Code: 2, 4, 18, 30, 53

Aeronautical Research Institute of Sweden (FFA)
Library
Box 11021
S-161 11 Bromma 11, Sweden

Telephone: 08/26 28 40
Cable/TWX: Flygtekniska Telex: 107 25
Director: Mrs. Brit Berg

Collection: aeronautics, aerodynamics, structures, instrumentation, engineering. Holdings: 2,000 full-size internally generated reports; 55,000 full-size externally generated reports; 500 microfilms; 10,000 bks, 200 journal subscriptions. Primary language: English. Holdings obtained from NASA, NTIS, BLL.

Retrieval: computerized; internally-generated reports by coordinated indexing system; externally generated reports by NASA categories.

Publications: FAA Reports (Meddelande); numerous internal memoranda and notes.

User Availability: Loan requests must be made through a library; free loan and Xerox services. Service delivery: oneday. Contact for services: Mrs. Brit Berg, Librarian

# APPENDIX 2B
## A LIST OF WORLDWIDE INFORMATION CENTERS

**SWEDEN Country Code: II Reference Code: 12, 24, 57**

**National Swedish Road & Traffic Research Institute**
**Information & Documentation Section**
**Drottning Kristinas vag 25**
**S-114 28 Stockholm, Sweden**

**Telephone: 08/34 03 80**
**Cable/TWX: None**
**Director: Ms. Bertil Strom**

Collection traffic engineering, geology. Holdings: 24,000 full-size externally generated reports; 225 journal subscriptions; 500 drawings; 440 full-size internally generated reports. Primary language: Swedish, English. Holdings obtained from SAE, HRB, SCANDOC.

Retrieval: For IRRD, computer retrieval.

Publications: Rapport (external); Internrapport (internal).

User Availability: Telephone or write for IRRD retrieval service, other library services. Free retrieval on IRRD; Retrospective search charge of $30-$125 question; SDI service charge of $30-$125/yr. Service delivery: varies. Contact for services: I & D Section.

**SWEDEN Country Code: III Reference Code: 8, 11, 17, 32, 41, 47**

**Research Institute of National Defence (FOA)**
**S-104 50**
**Stockholm 80, Sweden**

**Telephone: 08-63 18 00**
**Cable/TWX: 10366**
**Director: Dr. Lars Hogberg**

Collection: chemistry, biology, physics, electronics, nuclear engineering, materials. Holdings: 130,000 microfiche; 64,000 bks; 2,000 journal subscriptions; 1,800 bound journals; 50,000 microfilm; 25,000 full-size externally generated reports. Primary language: Swedish, English.

Retrieval: conventional indexing/cataloging systems/UDC; computerized services on GRA tapes & internally-generated files.

Publications: Numerous.

User Availability: Priority given to Swedish defense agencies; outside users given services as time permits. Minor services, e.g., interlibrary loans, free; publications charged at cost. Service delivery: varies. Contact for services: Dr. Lars Hogberg, Chairman of the Documentation Committee of the Institute.

**SWEDEN Country Code: IV Reference Code: 51, 54**

**Royal Institute of Technology (RIT)**
**Library-Documentation Department**
**S-100 44 Stockholm, Sweden**

**Telephone: 08-236520**
**Cable/TWX:**
**Director: Dr. Stephan Schwarz**

Collection: science, technology. Holdings: 250,000 bks; 7,000 journal subscriptions; 7,000 bound volumes; all Scandinavian standards; 7,100,000 references in machine readable form on magnetic tapes. Primary language: English.

Retrieval: computerized ABACUS information processing system; VIRA, a second generation ABACUS.

Publications: MechEn & Wood internal data bases.

User Availability: Write for all library services; charge of 400 SwCr/yr for SDI profiles; 500SwCr for retrospective search on ESRO-RECON on-line system. Service delivery: varies. Contact for services: Mrs. Zofia Gluchowicz.

## APPENDIX 2B
## A LIST OF WORLDWIDE INFORMATION CENTERS

**SWEDEN** Country Code: V Reference Code: 12

**Swedish Institute of Building Documentation (BYGGDOK)**
**H lsingegatan 49**
**S-113 31 Stockholm, Sweden**

**Telephone: 08/34 01 70**
**Cable/TWX:**
**Director: Mr. Adolf Stern**

Collection: Civil engineering; Primary language; Swedish, English.

Retrieval: conventional cataloging/indexing systems/UDC.

Publications: Building Abstract Service; Byggreferat; numerous reports.

User Availability: Write for retrospective searches and SDI services; charge of 90 SwCr/hour. Contact for services: Mr. Arne Astedt.

**SWITZERLAND** Country Code: I Reference Code: 51, 54

**Library of the Swiss Federal Institute of Technology**
**Information and Documentation Center**
**Leonhardstrasse 33**
**CH-8006 Zurich, Switzerland**

**Telephone: 32 62 11**
**Cable/TWX: 53 178**
**Director: Dr. J. P. Sydler**

Collection: science, technology. Holdings: 500,000 microfiche 1,100,000 bks. & periodical holdings; 7,000 journal subscriptions, 1,000,000 patents; all translated Russian periodicals. Primary language; German, English.

Retrieval: conventional indexing/cataloging system, with keywords and UDC; automated retrieval planned.

Publications: Schriftenreiche der Eth Bibliothek.

User Availability: register and pay user's charge for documents, copy services. Service delivery: varies with volume of work on hand. Contact for services: Dr. J. P. Sydler, Director.

**THAILAND** Country Code: I Reference Code: 51, 54

**Thai National Documentation Centre (TNDC)**
**196 Phahonyothin Road**
**Bang Khen, Bangkok 9, Thailand**

**Telephone: 791121-30, Ext. 34-39**
**Cable/TWX: Rescorp, Bangkok**
**Director: Mrs. Chalermvarn Choosup**

Collection: science, technology. Holdings: 16,134 bks; 295 journal subscriptions; 6,313 bound volumes; 1,176 patent volumes (British); 101,216 specs (norms); 395 translations; 2,000 theses; 1,075 microfilm; 45,552 full-size externally generated reports. Primary language: English.

Retrieval: conventional cataloging/indexing system; manual retrieval. Plans to use medium mechanized retrieval equipment.

Publications: Numerous.

User Availability: Write, telephone or telex for inquiries, bibliographic compilation, translation, and reprographic services. Charge of 2 baht per page for photocopies; 5 baht per 10 inch strip of microfilm; 15 baht per typed page for bibliographies; 80-100 baht per typed page for translations. Service delivery: 1-2 weeks. Contact for services: Mrs. Rachanee Kanchanomai, Responsive Service Unit.

# APPENDIX 2B
# A LIST OF WORLDWIDE INFORMATION CENTERS

**TURKEY** Country Code: I Reference Code: 17, 33, 35, 41, 42

CEKMECE Nuclear Research & Training Center
CNAEM Library
P.K. No. 1 Hava Alani, Yesilkoy
Istanbul, Turkey

Telephone: 73-75-16
Cable/TWX: REACTOR, Istanbul
Director: Mrs. A. S. Vere-Hodge

Collection: mathematics, nuclear physics, nuclear engineering, electronics, metallurgy. Holdings: 30,000 full-size externally generated reports; 4,500 bks; 200 journal subscriptions; 2,365 bound volumes; 2,500 translations; 20,000 microfiche. Primary language: English, French, German. Holdings obtained from U. S. AEC, IAEA, WHO, CEA.

Retrieval: conventional cataloging/indexing systems, UDC.; manual retrieval.

Publications: CNAEM Reports.

User Availability: Permission necessary from Director of Center; limited services to outside users. Photocopy charges @ 075. TL./page. Service delivery: varies. Contact for services: Dr. Fahir Yenicay, Director.

**TURKEY** Country Code: II Reference Code: 34

Mak-Dok Technical Documentation & Information Centre
Sumer Sok.: No: 36/1
Yenisehir-Ankara, Turkey

Telephone: 184197
Cable/TWX: P.B. 12 Yenisehir-Ankara Turkey
Director:

Collection: mechanical engineering. Holdings: 4,068 full-size reports: 2,586 bks; 105 journal subscriptions; 228 bound journals; 1,149 specs (norms) Primary language: English, Turkish. Holdings obtained from various Turkish universities.

Retrieval: conventional cataloging/indexing system, Anglo-American cataloging rules and UDC classification; manual retrieval.

Publications: Numerous technical books; monthly journal; weekly newspaper.

User Availability: Must be member of Chamber; information retrieval, ordered books, circulation, photocopy services free.

**TURKEY** Country Code: III Reference Code: 51, 54

Middle Eastern Technical University
Library
Ankara, Turkey

Telephone: 232120/190
Cable/TWX: METU Library Ankara
Director: Furuzan Olsen

Collection: sciences; technology. Holdings: 9,400 full-size externally generated reports; 128,100 bks; 2,008 journal subscriptions; 42,500 bound journals; complete Turkish standards; 250 films; 50 microfoils; German dissertations, filmstrips. Primary language: English. Holdings obtained from NASA, AGARD, U. S., Geological Survey.

Retrieval: conventional cataloging/indexing system, Library of Congress; retrieval manual and partially computerized.

Publications: Library Handbook; METU. Abstracts of Graduate Theses, 1956-71.

User Availability: Need to register at Library; all services available free. Service delivery: immediate. Contact for services: Head of Reader Services.

## APPENDIX 2B
## A LIST OF WORLDWIDE INFORMATION CENTERS

**TURKEY** Country Code: IV Reference Code: 15, 49, 51

National Productivity Center
Documentation Section
Mithatpase Cad. No. 46
Ankara, Turkey

Telephone: 17 91 96
Cable/TWX: Produktivite/ANKARA
Director: Mr. Ali Orhon

Collection: productivity, management, quality control. Holdings: 5,000 bks; 133 journal subscriptions; numerous miscellaneous publications on productivity. Primary language: Turkish, English, German, French.

Retrieval: conventional cataloging/indexing, Dewey Decimal system; manual retrieval.

Publications: numerous books; quarterly magazine; monthly bulletin.

User Availability: Write; all possible assistance within reason free. Service delivery: immediate. Contact for services: Mrs. Gulgonul Buyukdore, Information Officer.

**TURKEY** Country Code: V Reference Code: 8, 18, 24, 47, 54

Scientific & Technical Documentation Centre of Turkey (TURDOK)
225 Ataturk Bulvari
Kavaklidere, Ankara, Turkey

Telephone: 183155
Cable/TWX: TUBITAK, Ankara
Director: Mrs. Kismet Burian

Collection: engineering, biology, physics, geology, science, technology. Holdings: 8,000 bks; 710 journal subscriptions; 7,000 bound journals; all U. S., U. K. & Dutch patents from 1970; Japanese & Canadian patents from 1971; 1,245 Turkish Standards. Primary language: English, Turkish, German, French.

Retrieval: conventional cataloging/indexing system, Anglo-American, UDC for classification

Publications: Key to Turkish Science; serial abstract bulletins in 11 topics.

User Availability: Write for abstracting, retrospective searches, reprography, bibliographic compilations, translations, & reference services. Photocopy charge of 2 T.L/page ($0.15). Service delivery: varies. Contact for services: Mrs. K. Burian, Director.

**UNITED KINGDOM** Country Code: I Reference Code: 22, 27

AERE, Harwell, U. K.
Heat Transfer & Fluid Flow Service
HTFS Bldg., 392, AERE, Harwell, Didcot.
Berkshire, U. K.

Telephone: Abingdon 4141 XT 4016
Cable/TWX: ATOM HARWELL
Director: Mr. L. B. Cousins

Collection: heat transfer, fluid flow. Holdings: 16,000 full-size externally generated reports; 1,000 full-size internally generated reports; 200 bks; 2,010 journal subscriptions. Primary language: English

Retrieval: in-house retrieval system; computer programs written in ASSEMBLER & FORTRAN for IBM 370/165.

Publications: Numerous.

User Availability: Subscribe to Information Service @1,000-2,000/yr; subscribe to Digest @120-25/yr; plus joining fees. Current awareness bulletin and literature search of holdings. Service delivery: 1 hour-3 weeks. Contact for services: Mr. L. B. Cousins, HTFS Technical Information Officer.

# APPENDIX 2B

# A LIST OF WORLDWIDE INFORMATION CENTERS

**UNITED KINGDOM** Country Code: II Reference Code: 2

Aircraft Research Establishment
Manton Lane
Bedford MK 41 7PF, England

Telephone: Bedford 50681
Cable/TWX: 825056
Director: Mrs. F. M. Guinevan

Collection: aerodynamics. Holdings: 250,000 full-size internally generated reports; 20,000 full-size externally generated reports; 100 microfiche (planned expansion); 2,300 bks; 70 journal subscriptions. Primary language: English. Holdings obtained from TRC, RAE, NASA.

Retrieval: conventional cataloging/indexing system; manual retrieval.

Publications: A.R.A. Wind Tunnel Notes; A.R.A. Reports; A.R.A. Model Test Notes; A.R.A. Memos.

User Availability: Apply to Librarian with overseas requests routed to DRIC. Photocopies, interlibrary loans generally free or small fee. Service delivery: 1 week. Contact for services: Mrs. F. M. Guinevan, Librarian.

**UNITED KINGDOM** Country Code: III Reference Code: 51, 54

British Library (BL)
Lending Division
Boston Spa, Wetherby, Yorkshire LS237BQ
England

Telephone: Boston Spa 843434
Cable/TWX:
Director: Dr. D. J. Urquhart

Collection: science, technology. Holdings: 42,000 journal subscriptions; 250,000 translations; all worthwhile current English language monographs.

Retrieval: conventional cataloging/indexing systems; manual retrieval.

Publications: Numerous.

User Availability: Loan service available to U. K. organizations & overseas national centers; photocopy services available to all; as U. K.'s Medlars Centre will carry out literature searches. Charges vary. Service delivery: rapid. Contact for services: Director General, Dr. D. J. Urguhart.

**UNITED KINGDOM** Country Code: IV Reference Code: 4, 54

Cranfield Institute of Technology
Library
Cranfield, Bedford, England

Telephone: Bedford 51551
Cable/TWX: 825072
Director: Mr. C. W. Cleverdon

Collections: technology, management. Hodlings: 300 full-size internally-generated reports; 45,000 full-size externally-generated reports; 25,000 bks; 600 journal subscriptions; 10,000 bound volumes. Primary language; English.

Retrieval: conventional cataloging/indexing system, UDC; manual retrieval system

Publications: Numerous (Cranfield Institute of Technology reports)

User Availability: Write for services; anything within reason free. Contact for services: Librarian

# APPENDIX 2B

## A LIST OF WORLDWIDE INFORMATION CENTERS

**UNITED KINGDOM** Country Code: V Reference Code: 5, 37

**Defence Research Information Centre (DRIC)**
**St. Mary Cray, Orpington**
**Kent BR5 3RE, England**

**Telephone:** Orpington 32111, Ext. 35
**Cable/TWX:** 896866
**Director:** Mr. S. C. Schuler

Collection: Aerospace, military defense. Holdings: unspecified numbers of military specifications, federal specifications, drawings; MIL standards, handbooks, qualified products lists. Primary language: English. Holdings obtained from NASA, U. K.

Retrieval:

Publications:

User Availability: Government defense depts. & defense contractors in industries and universities; unlimited documents passed to British Library & TRC for outside distribution. Contact for services: Mr. S. C. Schuler, Head, DRIC.

**UNITED KINGDOM** Country Code: VI Reference Code: 20, 28

**Ergonomics Information Analysis Centre**
**University of Birmingham**
**P. O. Box 363**
**Birmingham B15 2TT, England**

**Telephone:** 021-472 1301, Ext. 2731
**Cable/TWX:**
**Director:** Mr. J. G. Fox

Collection: ergonomics; human factors. Holdings: 63,967 abstracts; 709 full-size externally generated reports; 225 specialized internally-generated bibliographies; 88 journal subscriptions. Primary language: English.

Retrieval: conventional cataloging/indexing systems; manual retrieval.

Publications: Ergonomics Abstracts (quarterly); specialized bibliographies.

User Availability: Write or phone for bibliographic services, interlibrary loans, and photocopy services. Charges for photocopies; special bibliographies @5p/page. Service delivery: loans & photocopies-minimum period of 2 days; bibliographies - 2 weeks. Contact for services: Mr. J. G. Fox Director.

**UNITED KINGDOM** Country Code: VII Reference Code: 25

**Geomechanics Information Center**
**Imperial College of Science & Technology**
**Rock Mechanics, Prince Consort Road,**
**London SW7, England**

**Telephone:** 01-589-511 Ext. 1525
**Cable/TWX:**
**Director:** Mrs. A. Gralewska-Vickery

Collection: Information retrieval system.

Retrieval: cataloging/indexing system using alphabetical keywords, index system, faceted classification; manual retrieval with by-products (1) abstract journal; (2) back searches; (3) profile service (SDI)

Publications: Geomechanics Abstracts

User Availability: By letter of request, free service for abstract journal, back searches, profile service (SDI). Service delivery: for back searches, one week; abstract journal from 1974, monthly; profile services, according to request. Contact for service: Mrs. A. Gralewska-Vickery.

# APPENDIX 2B
# A LIST OF WORLDWIDE INFORMATION CENTERS

**UNITED KINGDOM** Country Code: VIII Reference Code: 23

**High Temperature Reaction Rate Data Center**
**Department of Physical Chemistry**
**University of Leeds**
**United Kingdom**

Telephone: Leeds 31751, Ext. 6086
Cable/TWX:
Director: Dr. D. L. Baulch

Collection: homogenous gas phase reactions. Holdings: 5,200 full-size externally generated reports; 150 microfiche. Primary language: English.

Retrieval: conventional cataloging/indexing systems; inverted file with numerous search terms.

Publications: Evaluated Kinetic Data For High Temperature Reactions (book series).

User Availability: Limited information service; current info. & bibliographies provided for reactions evaluated by Center. Free. Service delivery: 1-4 days. Contact for services: Dr. D. Baulch, Dept. of Physical Chemistry.

**UNITED KINGDOM** Country Code: IX Reference Code: 1, 22, 28, 40, 53, 60

**Institute of Sound and Vibration Research**
**Tizard Library, The University**
**Southampton S09 5NH, Hants., U. K.**

Telephone: Southampton 559122 Ext. 2301
Cable/TWX: Southampton 47661
Director: Miss M. R. K. Bull

Collection: noise and vibration; structural dynamics, fluid dynamics, operational acoustics, audiology, automotive engineering, data analysis, human factors. Holdings: 500 bks, 50 journal subscriptions, 200 specs (norms), 1,000 full-size internally generated reports; 10,000 full-size externally-generated reports. Primary language: English. Holdings obtained from NTIS, Technical Reports Centre, National Lending Library, NASA.

Retrieval: conventional cataloging/indexing system; manual retrieval using STAR, IAA, Shock & Vibration Bulletins, JASA.

Publications: I.S.V.R. Technical Reports; I.S.V.R. Annual Reports

User Availability: on request, circulation of abstract cards, ISVR reports, reprints; charges made only for XEROX copies. Service delivery: soon after request. Contact for services: Librarian

**UNITED KINGDOM** Country Code: X Reference Code: 14, 36, 38

**Mineralogical Society of Great Britain and Ireland**
**41 Queen's Gate**
**London, SW7 5HR, England**

Telephone:
Cable/TWX:
Director:

Collection: Abstracting service. Mineralology, petrology, geochemistry, crystallography, gemmology, meteoritics. Primary language: English. Holdings obtained from Mineralogical Society of America.

Retrieval:

Publications: Mineralogical Magazine; Mineralogical Abstracts; Clay Minerals; Mineralogical Society Bulletin; Monographs

User Availability: Subscription; application for membership; services free depending on group joined. Contact for services: General Secretary

# APPENDIX 2B
# A LIST OF WORLDWIDE INFORMATION CENTERS

**UNITED KINGDOM** Country Code: XI Reference Code: 8, 51, 52, 54

Scientific Documentation Centre, Ltd.
Halbeath House
Dunfermline, Fife, KY 12 OTZ, U. K.

Telephone: DUNFERMLINE 23535
Cable/TWX: DUNFERMLINE 23535
Director: Dr. P. S. Davison

Collection: science, technology, biology, spectroscopy. Holdings: 14,000 bks/yr; 2,550 journals; spectra 186,000; 350,000 sets of data; 500,000 reference cards. Primary language: English.

Retrieval: conventional cataloging/indexing systems; manual retrieval, with punched card systems.

Publications: current awareness services.

User Availability: Subscription to Current Awareness service charges from 20L/yr. Service delivery: large services up to 1 month; on-line services offered subject to staff availability. Contact for services: Dr. P. S. Davison, Director.

**UNITED KINGDOM** Country Code: XII Reference Code: 15, 48, 51, 54, 56

Shirley Institute
Specialized Textile Information Service
World Textiles Abstracts Service
Manchester M20 8 RX, England

Telephone: 061-445-8141
Cable/TWX: 669386 Essdiel Mohr
Director: Mr. R. J. E. Cumberbirch

Collection: Textiles, polymers, science, technology. Holdings: unspecified thousands of bks; 400 journal subscriptions; 300 bound volumes; thousands of patents; hundreds of spec (norms); thousands of pamphlets & brochures. Primary language: English.

Retrieval: computer data bases.

Publications: World Textile Abstracts; Textiles; numerous others.

User Availability: Subscription or fee-paying service required for all services, including extended summaries, full translations, photocopies, info. retrieval, data base on magnetic tapes. Service delivery: Immediate. Contact for services: Mr. R. J. E. Cumberbirch, Head of Library & Information Department.

**UNITED KINGDOM** Country Code: XIII Reference Code: 43, 47

U. K. Atomic Energy Authority
Culham Laboratory
Abingdon, Berks., OX14 3DB, U.K.

Telephone: Oxford 41721
Cable/TWX: Telex 83189
Director: J. L. Hall

Collection: plasma physics, controlled nuclear fusion. Holdings: 30,000 full-size reports, 8,500 bks, 450 journal subscriptions, 3,500 bound volumes, 1,000 translations-Primary language: English

Retrieval: conventional cataloging/indexing system, UDC; computerized on-line data base of over 40,000 references; uses video terminal at 1200 baud

Publications: Numerous

User availability: Outsiders have access to weekly "Library Bulletin," and weekly "Selective Dissemination of Information" service; "Library Bulletin @L15 p.a.; "SDI" @L50 p.a.

# APPENDIX 2B
# A LIST OF WORLDWIDE INFORMATION CENTERS

**UNITED KINGDOM Country Code: XIV Reference Code: 11**

**U. K. Chemical Information Service (UKCIS)**
**The University**
**Nottingham NG7 2RD, England**

**Telephone: Nottingham 57411**
**Cable/TWX: 37488**
**Director: Dr. A. K. Kent**

Collection: chemistry. Holdings: bibliographic references to primary chemical literature; CAS computer readable data bases; CAS printed publications. Primary language: English.

Retrieval: computerized chemical data bases.

Publications: Macroprofiles

User Availability: Subscription to computerized search services; charges vary. for Contract services: Dr. A. Kabi, Manager, Service Dept. UKCIS.

**UNITED KINGDOM Country Code: XV Reference Code: 32, 53**

**University of Aston in Birmingham**
**Biodeterioration Information Center**
**80 Coleshill Street**
**Birmingham, England B4 7PF**

**Telephone: 021-359 3611 Ext. 229 or 6258**
**Cable/TWX: 336997**
**Director: Dr. H. O. W. Eggins**

Collection: Biodeterioration of materials and structures. Holdings: total of 25,000 documents, including journal articles, reports, and books. Primary language. English.

Retrieval: Convention cataloging, indexing system, conventional subject index with own classification system

Publications: Biodeterioration Research Titles; Waste Materials Biodegredation Titles; International Biodeterioration Bulletin

User Availability: Subscribers to publications have limited free access to inquiry service; all other inquiries charged at 5L an hour. Copies of documents supplied. Contact for services: Dr. A. Allsopp, Research Fellow

**UNITED KINGDOM Country Code: XVI Reference Code: 14**

**University of Cambridge**
**Crystallographic Data Centre**
**Lensfield Road, Cambridge, England CB2 1EW**

**Telephone: 0223-6649**
**Director: Dr. Olga Kennard**

Collection: bibliographic and numeric data on organic and organometallic crystal structures. Holdings: 5-10 journal subscriptions, several hundred translations, 10,000 full-size externally generated reprints, numerous chemical diagrams for all compounds, bibliographic, numeric data, protein data, chemical connection table file, electron diffraction and microwave file, all on magnetic tapes. Primary language: English. Holdings obtained from primary world literature and C.N.R.S. ("Bulletin Signaletione").

Retrieval: Files organized by 86 chemical classes; bibliographic file has entries sorted by molecular formule within classes; 80 column card image records on magnetic tape.

Publications: "Molecular Structures and Dimensions," Vols. 1-4 (V. 5 in progress); "Interatomic Distances 1960-65, Vol. A1"

User Availability: By letter, manual searches provided; bibliographicaservices including hard copy current awareness, magnetic tape current awareness, retrospective search to 1935, numeric data service. Charge of L-15 yearly for bibliographic hard copy. Service delivery: average two weeks. Contact for services; Dr. D. G. Watson.

# APPENDIX 3
# BIBLIOGRAPHIES, DIRECTORIES AND TECHNICAL ARTICLES

## *BIBLIOGRAPHIES AND DIRECTORIES*

*Abstracting Services In Science, Technology, Medicine, Agriculture, Social Sciences, Humanities.* The Hague, FID, 1965.

Akinrele, I. A., et al., ed. *Directory Of Scientific Research In Nigeria.* Lagos, Nig., Science Association of Nigeria, 1968.

Anderson, B. J., comp. *Special Libraries And Information Centers In Canada: A Directory.* Ottawa, Canadian Library Association, 1970.

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# ENVIRONMENTAL INFORMATION SYSTEMS

Marta L. Dosa (Ph.D.)
Associate Professor
Syracuse University
Syracuse, New York 13210

## SUMMARY

The paper treats two broad aspects of the topic: (1) Research, academic and popular trends in the environmental field, (2) characteristics of information users, resources and systems, with examples. The multidisciplinary nature of environmental information is analyzed. The following operational definition is used: "Like any science, ecology provides an inclusive and consistent structure for perceiving the world; but, unlike other sciences, it also attempts to account for the behavior of man within the world structure."

Current and potential audiences may be found in almost all fields of knowledge and professional practice. Their needs include (a) research and technical data, (b) information for policy and decision makers, (c) information for the participating public. Knowledge available for each of these audiences is fragmented and scattered. In addition to traditional forms of data, institutional and individual expertise has been recognized as an information resource of growing importance. Systems yielding environmental information are categorized as (a) problem-centered, (b) discipline-oriented. The challenge to the user and the information specialist is threefold: (1) the complexity of institutions supporting and operating information systems and their interrelationships, (2) rapid emergence of new organizations such as the United Nations Environment Programme, (3) the need for innovative approaches to information transfer outside of formal systems.

## Objectives

One could use any number of approaches to my topic. I could try to avoid the danger spots: definitions, analysis, integration. I could attempt some sort of a survey of information resources and services. I am not going to choose that option, although I will mention a few characteristic systems.

My purpose is twofold: (1) to look at some trends and symptoms in that amorphous phenomenon called the environmental field and to make some observations relevant to communications, information transfer and use, (2) indicate major types or information sources with examples.

## I. OBSERVATIONS ON THE NATURE OF ENVIRONMENTAL SCIENCE

### I.1. Terminology: Rejections and additions

"If you want to converse with me, define your terms," demanded Voltaire. But even he would have a hard time defining the three elements in the title of this lecture. Each of them could be assigned a whole range of meanings and interpretations, depending on their context. I shall not attempt any precise definition of "information system." I have no particular quarrel with the loose, often criticized denotation of a "system" handed down by the old guard of general systems theorists, "Sets of elements standing in interaction." [1]

The term "information" is particularly elusive and resistant to any widely acceptable definition. In various interpretations it has been referred to as a symbol, a phenomenon, a natural resource, a commodity, a tool. Thirty-nine definitions have been examined by Hans Wellish in 1972 and found to various degrees unsatisfactory for universal usage by information scientists or informatologists. [2] A recent survey of the literature of "information" was published by the Center for the study of Information and Education at Syracuse University. [3] Interpretations of the term usually move in the general domain. Each would have to be examined in the framework of the environmental field. That process is outside of the scope of this paper. Instead, I would like to share with you two definitions that seem to be relevant to the science of ecology, a poetic/symbolic one and a practical/operational one.

J. Bronowski, mathematician and fellow of the Salk Institute in California, said that Leo Szilard's pioneering paper, published in 1929, treated "what would now be called Information Theory: the relation between knowledge, nature and man." [4] A more pragmatic interpretation was given at the Symposium on Problems Relating to Environment, sponsored by the Economic Commission of Europe:

> Information includes the total complex of data and facts which people receive from outside and which contribute towards their knowledge. It may be said that information creates opinion about an object in a given environment." [5]

The behavioral orientation of this definition is underscored by the following words:

> It is clear that the above-mentioned definition of information relates to the component of an attitude. According to this line of thinking, the promotion and dissemination of information constitute an integral part of education. [6]

In the context of the international environmental movement the attitude toward "public education" varies from one cultural area to another. Some ideologies object to mass education if it means influencing people's values and behavior. Others utilize it as a possible way to social improvement. The conflict may seem removed from a scientist's sphere of concern. However, as an OECD paper stated, "It is no longer possible to separate information and knowledge in the social sciences from those concerning the natural sciences." [7] This is especially true for issues that have a tendency to surface in our societies as crises or movements. Although the emotional force of the ecological movement peaked in 1972, at the time of the United Nations Conference on the Human Environment at Stockholm, communications in the field are still influenced by value judgments and individual and group attitudes. Now in the collective mind of the public the "environmental crisis" has been replaced by the "energy crisis." However, as far as data use and information transfer are concerned, the two issues are inseparably entangled. Both are highly susceptible to the influence of subjective considerations.

At this point it would be reasonable to define, at least for the purpose of our discussion, the discipline or set of disciplines variously referred to as "environmental science," "environmental studies," or "ecology." We are still at a loss to follow precisely the line of development from early botany to the fashionable ecological awareness of our mass culture. The term "ecology" (based on the Greek "oikos-," meaning household) seems to have been first used in 1869 by the German biologist and zoologist Ernst Haeckel, denoting a whole range of scientific activities. When the nineteen sixties transformed the field into a broadly based, multidisciplinary, highly publicized concern for the quality of human life, the search for a relevant new definition began. In 1969 "environmental science" was defined as "basic and applied inquiry about changes in environmental quality resulting from the activities of man." [8] Of course, the mere reference to "the activities of man," at least in the framework of industrialized countries and their dominant lifestyle, conjures up a vast vision of complexity and confusion. Therefore, the following definition seems to me more indicative of the pyschological and sociological orientation of the field:

> Like any science, ecology provides an inclusive and consistent structure for perceiving the world; but, unlike other sciences, it also attempts to account for the behavior of man within the world structure. [9]

## I.2. The Role of Communications

Human communication is an overworked, slippery subject. Already years ago Peter Drucker charged that there were too many interpretations of the concept. "The noise level has gone up so fast that no one can really listen any more to all that bubble about communications. But there is clearly less and less communicating. The communications gap within institutions and between groups in society has been widening steadily - to the point where it threatens to become an unbridgeable gulf of total misunderstanding." [10] Many theories have been proposed as to the fundamental causes of this "communication regression." One theme emerges with persuasive consistency, that of alienation. Let me use this particular human experience - not really new but brought into sharp focus by our time - as an example of the psychological barriers to communication.

In one of his poems the Russian poet, Gumilev tells of a bewitched violin. Whoever starts to play it must go on and on, without stopping. He will be followed by hungry wolves and monsters. The minute he would stop playing they would attack and devour him. But a young man, intoxicated by dreams of his future, refuses to see the danger. Finally he gets hold of the mysterious instrument. Now he will have to look into the eyes of monsters, he is told, and at the end he will die a "horrible and glorious" death.

There is, in this tale, a dark fascination with unknown danger, a hint of the possible beauty of the inevitable, violent end. It reminds me of the image of post-industrial man, drawn by the prophets, poets and scientists of the ecological movement, an image of blind race toward self-annihilation. Rampant technology, speed and alienation from nature are the bewitched violin. And now, some of our visionaries say, man may not be able to stop any more, he will be devoured by his self-created monsters. The tenor of one large branch of the environmental movement is as darkly pessimistic as Gumilev' poem. However, in the tale of our civilization it is not the violin that is bewitched, but the player himself. In our version of the fable, mankind is so fear-ridden, so terrified from the texture of our life that it goes on and on without stopping, without thinking, escaping into, and at the same time creating more and more complexity.

This nameless sense of insecurity and alienation drives the individual into a search of enclaves, hide-outs, groups, communes, microcultures, pockets in society -- whether based on race, religion, ethnicity, age or other forces of cohesion. [11] "All of us are both running scared and longing for community," says the anthropologist Paul Bohannan. [12] In the process of running - playing the bewitched violin - we constantly increase the complexity of both of our worlds, the large-scale culture of institutions, organizations, networks, political and economic relationships, and the microculture of our own chosen enclave.

If we accept the assumption that each of us - information users as well as information professionals - is likely to move back and forth between two such worlds without even realizing their separateness, the question is, what does this do to our carefully studied abstractions and practices of information exchange? Envision a microcosm of an information system. Two individuals face each other, one is just beginning to formulate an information query, the other is watching for clues to better understand it. At this point they are both part of the same, organized and overt world. They "communicate." But indeed, do they? A shadow of a facial expression, an almost inperceptible change in the cadence of a voice could antagonize the other person and transport his inner self far into that "other", tribal and hidden level. It is probably fairly safe to say that the more involved, ambiguous and controversial a field of inquiry is, the stronger the possibility that interpersonal tensions will undermine interactions.

## I.3. Characteristic Trends

Let me now take a brief look at some characteristics of the environmental field that render the communication of information especially problematic. I have selected four examples. These are only indicative of difficulties.

*I.3.1. Research, development and action in the environmental field are problem-focused rather than discipline-oriented*. In a UNESCO-sponsored study Pierre de Bie, from the University of Louvain, offers the following explanation: "Problem-focused research is responsive to, and to some extent depends on, social needs, which determine its scope; it is focused on the problems which call for scientifically informed action." [13] Child abuse, gerontology/geriatrics, planning for recreational facilities, population control, thanatology, and transportation are other examples. M.I.T.'s program in urban geometrics conducts research in computer-based planning for traffic flow, public transportation services such as "Dial-a-Ride," and new approaches to neighborhood renewal. Implementation is in the hands of contracting local governments and various professional practitioners. We are dealing with two different sectors of a problem-centered field, each with its own activities, approaches, methodologies and channels of communications: (1) the community of researchers, (2) the community of practitioners. Differences between the two are neither clear-cut nor static. The same individual may play many roles. He can be a landscape architect, a regional planner, a researcher and a lecturer. But such individuals are rather rare, and their private worlds are growing enormously complex. In spite of the fact that they are interlinked by conferences, projects, consultantships, training programs, committees, advisory groups, panels and that galvanic breed called "gatekeepers," research and practice still inhabit two separate planets. Thus their processes generate different sets of information and bodies of knowledge.

Data resulting from the research process are imbedded in progress reports, laboratory notes, in-house memoranda, grant proposals, colloquia papers, office files, unpublished manuscripts, hydraulic maps, aerial photographs, survey analyses, computer tapes, and many other packages. Information users not familiar with the structure, relationships and "tribal" customs of researchers in certain specialities usually have a hard time detecting where, why, in what form and for whose use research data have been gathered and stored. On the other hand, information generated by the processes of professional practice are needed but not easily located by researchers. At every turn of a professional practitioner's daily routine, at every phase of an agency's work some form of potential information is produced. Policy statements, guidelines, hearings held by legislative and regulatory bodies, environmental impact statements of agencies, standards and specifications, technical memoranda, procedure manuals, case studies, inter-agency and inter-company communications, inventories, teaching aids and the brochures of public service agencies illustrate potential environmental information sources which emanate from the field of practice.

The need for open channels of information flow - research findings interpreted for the practitioner and the pool of professional experience of practitioners recycled as raw material for research - has been often stressed. The interdependence of management and social science research was illustrated by a case study in the *American Journal of Public Health*. A public health administrator must realize "that the success of any public health central program depends upon the degree of acceptance of that program by one or more individuals or groups in the community .... [he must realize] the importance of obtaining the best data available on factors associated with public acceptance or rejection of various programs, services, and patterns of operation." [14]

I suggest that information systems have to be evaluated in the light of all types of information generated by research and practice. What is the relationship, if any, between research findings on an ecological problem and the current methods and applications in the field? Are agencies, organizations, public interest groups aware of alternative solutions? Do agencies and organizations maintain information systems that act as switching mechanisms between the research sector and the public? These and similar questions must be asked before one can formulate some meaningful expectations in relation to environmental information services.

*I.3.2. Ideologies and behavioral patterns*. From scholarship to social activism, a dichotomy of views on the conflict between economic and technological development and the quality of life is clearly discernible. Historian Lynn White, Jr., in his 1967 paper equated what he called "the distinctive western tradition of science" with man's destructive dominance over nature.

> "By destroying pagan animism, Christianity made it possible to exploit nature in a mood of indifference to the feeling of natural objects." [15]

"In my opinion,-retorted René Dubos- the theory that Judeo-Christian attitudes are responsible for technology and for the ecological crisis is at best a historical half-truth." [16] At the U. N. Conference on the Human Environment in 1972, Barbara Ward Jackson, deeply moved, declared "At last, in this age of ultimate scientific discovery, our facts and our morals have come together to tell us how we must live."[17] Physicist John Maddox, editor of *Nature* and author of The *Doomsday Syndrome* charged: "The United Nations Conference. . . . seems to me to have been a splendid exposè of the inconsistencies with which the environmental movement has lumbered itself in the past few years." [18] The "elitist" and "middle class" nature of the ecological concern came under criticism by planners and activists at a national conference on "The Environment of the Open Society" early in 1973. The Borough President of Manhattan summarized the feelings of numerous participants, rejecting the "growing use of the rhetoric and symbols of the environmental movement by those who seek to confine minorities and poor people to the environment of the ghetto." [19]

The conflict between two opposite expectations, environmental clean-up and technological development, is both a domestic and a global problem. In the economically developed countries, national policies became more and more concerned with technology assessment. At a Symposium of the U. N. Economic Commission of Europe in 1970, numerous countries reported on legislation in this direction. In the United States the establishment of the Office of Technology Assessment demonstrated the need for more adequate scientific information for the Congress. (Public Law 92-484, October 13, 1972.) In an excellent study published by the Library of Congress' Congressional Research Service, fifteen case studies, including those on Project Camelot, the Salk vaccine, Thalidomide and national water policy, illustrate the level of scientific sophistication and information that formed the basis of legislative decision-making. [20] Wrote the *Saturday Review* of the report: "... one of the most underrated studies of the decade - a landmark reference work that will be useful to students of government for years to come." [21]

In June 1972, many of the delegates who attended the World Assembly of Non-Governmental Organizations Concerned with the Global Environment held in Geneva, came from Third World countries where, in the face of hunger, subhuman housing and high infant mortality the environmental concern seems a luxury item. They insisted that any international information exchange or referral system must be designed with countries in mind that do not have advanced computer capability. Representatives from Asia, Africa and Latin America offered the following formal statement:

> We are deeply convinced that environmental discussions should be people-oriented; the worst aspects of environmental degradation are the annihilation of so-called primitive peoples, apartheid, the obliteration of traditional cultures irrespective of their inherent values, and the growing disparity between the rich and the poor nations and,within nations, between the elite and the mass of the people. [22]

A recent Ford Foundation report observed that countries in South East Asia were reluctant to introduce environmental measures fearing loss of industrial development. On the other hand, The Asian Institute of Technology and the universities of the Philippines and Malaya were reported to have developed methods for environmental evaluation and introduced curricula in ecology-oriented subjects. [23] Questions of development versus unpolluted air, cost-benefit relationships in environmental control, and socio-cultural balance between old life styles and new ones will have to be faced by each country individually.

I.3.3. Public Interest in Governmental and Legal Processes. The twin forces of consumerism and ecology, magnified by the mass media, produced a keen public curiosity about legislative, regulatory and judicial affairs. Widely discussed issues such as the SST, the Alaska pipeline, the world oil crisis and the tunnel under the English channel, permeated the public mind. Heroes of the past have been replaced by figures and institutions symbolizing the consumer movement, for instance in the United States Ralph Nader and the Center for the Study of Responsive Law. Various types of public-interest organizations and groups emerged in all industrialized regions and in a few developing countries. Their activities include critical reviews of environmental action, the mobilization of public opinion in favor of new legislation, the interpretation of technical information for the public, and the representation of various consumer groups. The International Institute for Environmental Affairs, the Scientists' Institute for Public Information, the Society for Social Responsibility in Science, Resources for the Future, Inc., and the Natural Resources Defense Council are examples of such organizations in the United States. At the international level, the International Union for Conservation of Nature and Natural Resources (Morges, Switzerland), maintains an Operations Intelligence Centre for use by the membership and the public. The International Association Against Noise, (Zurich, Switzerland), The International Planned Parenthood Federation (London, England), and The International Union of Air Pollution Prevention Associations (Dusseldorf, Germany) illustrate organizations with specialized mission. The explosive growth of these organizations in recent years demonstrates the upsurge of public and professional concern. The rapid emergence of new groups, reorientation of old ones, mergers and joint projects make it difficult for the public to keep up to date on current programs. In addition to standard sources such as the Yearbook of International Associations, unexpected data on organizations can turn up in non-directory sources. For instance, lobbying groups in the United States are profiled in the Congressional Quarterly.

At the First National Environmental Information Symposium in 1972, legal information emerged as a social need shared by almost all elements of the environmental movement. One heard complaints that it was in the search for legal information where the urban planner lost valuable time, the social agency missed a deadline for a grant application, and the neighborhood organizer became frustrated. If improvement of existing conditions were to start with bill-drafting and lobbying, it became crucial for citizen groups to become politically sophisticated. But statutes, regulations, and judicial opinions needed condensation and interpretation for public use. One of the best-attended lectures at the symposium conceptualized a proposed legal information system. [24] The data base would include statutes, current legislation, pending legislation, pending litigation and rulings. What had been the prerogative of the legislator and the professional lobbyist, was now demanded as a basic right by the public: to become aware of bills before they were enacted and of judicial rulings as soon as they were reported.

There are at least two reasons why people interested in information as a social process would also be interested in law and its institutions. First, because the new public interest in law is likely to create new challenges and opportunities for system designers. Thus new solutions in legal information may be forthcoming. Second, because law presents a most interesting social study. Its often neglected, yet enduring philosophical basis has a meaning beyond its regulatory utility. Consider the implications of this statement: "... The legal process is a formal method of translating special goals into viable realities under visible concerned scrutiny." [25] For instance, using the evidence - questioning - debate - critical appraisal method, the adversary process investigates not only alleged criminal acts but also rational challenges to existing laws and to the social-political establishment. The increasing public interest in consumer-protection lawyers, class suits and legal battles such as Scenic Hudson Preservation Conference versus Federal Power Commission, maybe tells us something about the impatience of large segments of society. As one observer noted, "If the scientists provide the ideology for the ecology movement, the public-interest lawyers are the movement's political wing." [26] If we accept the assumption that information, like law, has the potentiality to become a social and political force, parallels between the two fields may give us some interesting insights.

I.3.4. Changes in academic and research programs - concepts, structures, relationships. If citizen inquiry into governmental and legal processes is posing a growing demand to public information processes, the drastic shifts in higher educational programs keep academic researchers and scholars wondering about their research collections. Let me give a few examples.

Colleges of agriculture and forestry have moved, over a period of several years, from a narrow consideration of scientific and technical aspects of their own disciplines toward a broader interpretation of their fields. Forest science has been called upon to deal with resource allocation among competing land uses, affecting the utilization of timber, mining practices, influence on industrial and residential development, open space preservation, recreation. Long standing practices such as clear cutting and prescribed burning come under scrutiny. In the wake of changing concerns and emphases, schools of conservation and departments of forestry have changed into schools of environmental science. New courses and seminars emerged, demanding new, cross-disciplinary information facilities. In the New York State College of Environmental Science and Forestry a graduate design study focused on "The Great American Sell," studying highway signs as a form of visual pollution. "Travel" - says the brochure - "is accompanied by an overwhelming shock of a motion-picture-like, multi-media barrage of colors, forms and slogans."

At Yale a history professor revises his approach to the teaching of early American History. "Suddenly all the scholarly assumptions about the frontier have changed" - writes historian Howard R. Lamar - "as students look with a fresh consciousness at the Indian, the Mexican-American, the pioneer woman and the environment destroying 'hero'." In the early 1940's Yale acquired the libraries of six great collectors of Western Americana. In these 30 years, the nature of inquiry into this invaluable collection of manuscripts, newspapers, paintings, maps, rare books underwent a curious change. In Lamar's words:

> Ten years ago the student probably would have reported on New Deal Indian policy; 20 years ago he would have talked about an Indian war or Custer's 'Last Stand.' In less than 10 years Indians have become in white eyes - and in history courses - peoples, societies and cultures. [27]

So today the student searches for information on Handsome Lake, a Seneca Indian whose religious teachings guided the tribe at the end of the 18th century. At the same university an interdisciplinary faculty committee studying the university's best course in the complex field of urban studies found that the department of city planning was in such "confused and transitional state," that it deserved the description of "rampant schizophrenia," leveled at it by an urban economist. The university had no institutional framework for organized knowledge and skills for the study of urban environments. In 1970 the committee recommended that Yale begin "immediately to build... a Concilium on the Environment or some similar interdisciplinary effort." [28]

At Cornell, a crisis in undergraduate education in population studies prompted the university's International Population Program to reassess the relationships between demography and environmental issues, to restructure the curriculum and to start a new publication program for the dissemination of new insights. One of the major reasons for a realignment of disciplines was thus identified by a Cornell catalyst:

> Traditionally, the study of human population dynamics, including causes and consequences, has been 'reserved' for demographers trained in the social sciences... with some selected aspects of this general area reserved for geneticists and various kinds of ecologists. Recently, however, it seems ... that the "rules" governing this academic division of labor have become inoperative and that anyone, either with an advanced degree or a soapbox, feels competent to discuss the intricacies of population dynamics [29]

Analogous examples may be found in practically all disciplines and professional fields of study. As the visions of individuals in these fields expand to broader and broader perspectives, curricula change, new journals, current awareness services with a crossdisciplinary thrust emerge and faculty and students become increasingly community action-oriented. Most traditional outlines of institutional relationships are being swept away.

## II. NOTES ON INFORMATION SYSTEMS

### II.1. Information Users: Characteristics and Needs

In an oversimplified model, a consideration of information systems prompts discussion of at least three components: (1) Information users, their characteristics and needs, (2) categories and nature of information resources, (3) an information transfer mechanism to interlink users and resources. Each of these components and their processes should be viewed in the larger context of trends, communication problems, and interrelationships, charted in the foregoing section. I will argue that in order to do any justice to the versatility, changeability and dynamics of information that moves in and out of the private world of an individual, an additional element should be introduced into this model: the "information problem/context." First, however, a glance at information user groups as they are most frequently conceptualized by studies, is in order.

II.1.1. Traditional Approach of the Use Study. There is hardly any journal, conference or educational program designed by or for information professionals that would not devote considerable space and time to the needs, demands, habits, information seeking and use patterns of their clientele. The research front has been taking a strong interest in the empirical testing of the expectations and responses of information audiences, and systems management has come to depend on the use study as a planning tool. The quality of studies has been very uneven, but that is not our point here. The majority of studies involve user groups delineated by such factors as the subjects' organizational affiliation, profession, task, research orientation, etc. Some of these approaches have more potential for the environmental field than others. I will mention those categories that are most frequently encountered in the literature.

a. Organizational affiliation. The information use habits of scientists working for government, industry or educational institutions have been tested. R and D laboratories, product engineering departments, university science departments and professional schools served as settings. This approach provides some insights into the ways scientists as information users are influenced by their immediate environment.

b. Discipline. Well-known studies have been done on information use by physicists, psychologists, chemists, medical researchers. Professional associations originated a number of these as preliminary steps toward changes in the formal communication system of the particular discipline. [30]

c. Mission, project or task. Numerous investigations conclude that identification with a project influences information use behavior. Because of the multidisciplinary nature of many of the mission-focused areas, this type of study is most relevant to our interests.

d. Professional role. What differences can be detected between the information/data requirements of basic, applied, and problem oriented researchers, decision makers, administrators, practitioners, educators or planners? Each of these groups receive research attention. These studies are worth exploring because each of these roles and activities can be envisioned in the context of environmental science.

e. Research methodology and style. It has been shown that individuals engaged in various types of research display different attitudes toward information. Research styles affecting the ways people look for information include archive based historical research as well as quantitive, laboratory, and field research.

f. The invisible college. In the late 1960's and early 1970's, studies on the communication patterns of scientists developed and eventually transplanted into the general literature the idea of an undefined, elite group in a given research field, whose members depend on each other for peer recognition and awareness of current affairs in their discipline. [31] Research on the informal workings of such groups presents some models potentially useful for the environmental field, where formal communication relationships are too new to be really effective.

Additional categories of information users have been proposed, but these may suffice as examples. With the exception of studies on the invisible college and mission-oriented groups, these traditional ways of examining information use seem too one-dimensional where the complexity of ecological information is concerned.

Two research trends deserve mentioning because of their relevance to problems experienced in environmental information. One is the interest in the scientist's search for information outside of his own area of specialization. Lack of familiarity with members of the invisible college, the terminology and classification schemes handicap his information seeking from the outset. [3] The other trend produced studies on the ways knowledge is diffused across national boundaries. In this regard especially insights into the role of the "international gatekeeper" are valuable. [33]

II.1.2. Audiences for Environmental Information. The potential environmental information clientele can be subdivided into (1) general audiences, and (2) specialized audiences. General audiences play a significant role in environmental information transfer because (a) they often form the target of public educational programs or publicity campaigns such as recent efforts to persuade consumers to save fuel resources, (b) they represent the clientele of public interest groups, (c) they are likely to influence the development of new information systems that would provide technical information in easily understandable form.

Specialized audiences may be subdivided into "scientists" and "technologists." In the environmental field this type of division would not accommodate the many types of special information needs. A few examples will show the variety of potential information-seeking situations:

Researchers in a well-defined discipline of basic science.
Researchers in a multidisciplinary area.
Researchers in a well-defined discipline of applied science.
Social science researchers.
Decision-makers, policy planners, legislators, management.
Professional practitioners in science and technology.
Skilled paraprofessionals.
Educators at all levels of the educational process.
Students at all levels of the educational process.
Members of special interest organizations, public interest groups, lobby groups.
Opinion leaders, gatekeepers, communication stars.

II.1.3. The Protean Information User. The shifting character of our society has been often identified with complexity carried to its extreme. But even this very term is becoming too pale to express a sense of inter-relatedness of all things. "... The term complexity, which belongs to a static, state-describing vocabulary, needs to be supplemented, if not yet supplanted, by a dynamic, process-describing equivalent as implied in the term complexing." [34] Versatility and flux permeate the information scene. Both the human process of information switching and its social technological mechanisms are fragmented and convoluted. The head of the U.S.'s National Technical Information Service acknowledged that although changes in the past 15-20 years "have greatly improved the potential (and, in some cases, the actual) performance of the technological information system, they also vastly complicated its structure and use." [35]

The scientist stands at the intersection of innumerable invisible lines, each potentially connecting him with a social, professional, institutional or subcultural communication system. Dare we assume that in the midst of constant cultural and psychological changes, his priorities, motivations and information seeking habits remain unchanged? Is he still identifying with "traditional" values such as formal professional rewards (implying ever-increasing pressures and demands on his privacy), or are his emphases shifting to the unmeasurable value systems of any one of the emerging subcultures, be it an encounter group, a "liberation" movement, a form of social activism or an avocation? I suggest that more reflective insight and research into the individual as a whole system is needed before we could answer such questions.

A compelling model of an emerging psychological style is offered by a Yale psychiatrist, R.J. Lifton.

He speaks of a new kind of individual, symbolized by the form-changing Proteus. Elements of the Protean profile include

> changing and fluctuating life style and habits, penchant for experimentation and exploration, search for new forms, attitudes, approaches, beliefs, fragmented impressions and spontaneous reactions, tendency to defy categorization and generalization, readiness to embrace, abandon and reembrace sets of values and priorities.

The term "character" and "personality" cannot describe the Protean individual. Lifton prefers the term "self-process", suggesting motion and changeability. His usage of the language as a mirror of socio-psychological change parallels the above mentioned example of "complexing" substituted for "complexity." For it is quite possible, Lifton writes,

> that even the image of personal identity, insofar as it suggests inner stability and sameness, is derived from a vision of a traditional culture in which man's relationship to his institutions and symbols are still relatively intact - which is hardly the case today. [36]

The ideas of the Protean information user is disquieting enough to suggest that one must search for new ways to conceptualize individual information use.

### II.2. The Information Problem/Context

It has been said that the success of an information seeker depends on the system's responsiveness to his purpose. How do systems become aware of the inquirer's objective that, in most cases, had not been spelled out in the original question addressed to the system? The classical question negotiation, if sensitive, will usually detect the client's topical interest, professional frame of reference, mission or task, time and cost constraints, and even personal preferences as to form or depth of material. What most information professionals shun is the (even mental) question: "What use will be made of this information?" Any probing in this direction would seem to violate the client's right to privacy. This is not the place to dissect a problem of such complexity. But this is a problem recognized by many as unavoidable. Let us assume that, working on the basis of models in other service professions, we can build an ethical context for professional counseling, a process which would lead to the client's indication of his purpose, if awareness of his purpose would, indeed, be necessary for successful problem solving.

What the client intends to do with the data or other information may, in a consumer-oriented system, determine the best form or "package" in which the information should be delivered, and maybe even the speed and mode of delivery. In industry, top management is said to want a tight summary, middle management a description, and people at the development level every detail of a new process. Queried about a region's flood-vulnerable land at a time of rapid spring thaw, a regional planning office will probably supply detailed engineering drawings to a civil defense group, and a set of aerial photographs to the local press. An instructor from a local college would use the same set of photographs for his class in photojournalism. Moreover, an information user may need the same data or documents for different purposes. The same item may be used by our instructor for dramatic visual illustration of a reportage, or for demonstrating the technical precision of a 1:4,800 vertical photo. He may intend to reproduce the information by photographing it, making a blow-up, using it as an illustration in a textbook or converting it into a slide. His objectives may be educational, political, social/environmental or scientific, and they may be professional, semi-personal or personal. In each case various legal, ethical, economic or technical constraints may apply. [37] However, a consumer-focused service, although mindful of the constraints, would be more interested in knowledge of the user's purpose in order to assure optimal delivery.

Let us call the purpose for which the information is being obtained the problem/context. This is the element I propose to add to our model of an information system that originally included (a) user, (b) sources, (c) information transfer mechanism. (Figure 1).

I envision the problem/context of an information query as a combination of (a) the information user's environment (e.g., a photojournalism class in an academic setting) and (b) the use that will be made of the information (e.g., teaching visual/emotional interpretation or technical skill.) As we are able to classify concepts and bits of knowledge, we should be able to classify sets of information problems-in-context. The following examples may give some indication of the potential of this consideration.

Education/photojournalism/historical study
- /professional aspects
- /legal aspects
- /marketing
- /cost studies
- /textual description
- /technical data
- /photointerpretation
- /demonstration media
- /reportage-techniques

Part of the larger problem/context ("where, how and for what purpose") are the scope and type of information, ("how much and in what form?") Except for browsing, specialized information users usually know the purpose of their search, but they are not always clear as to its scope or the type of information which would fit their objective. Below I list some examples where the scope and type of information determine the choice of sources and processes. The order of items does not imply any qualitative weights.

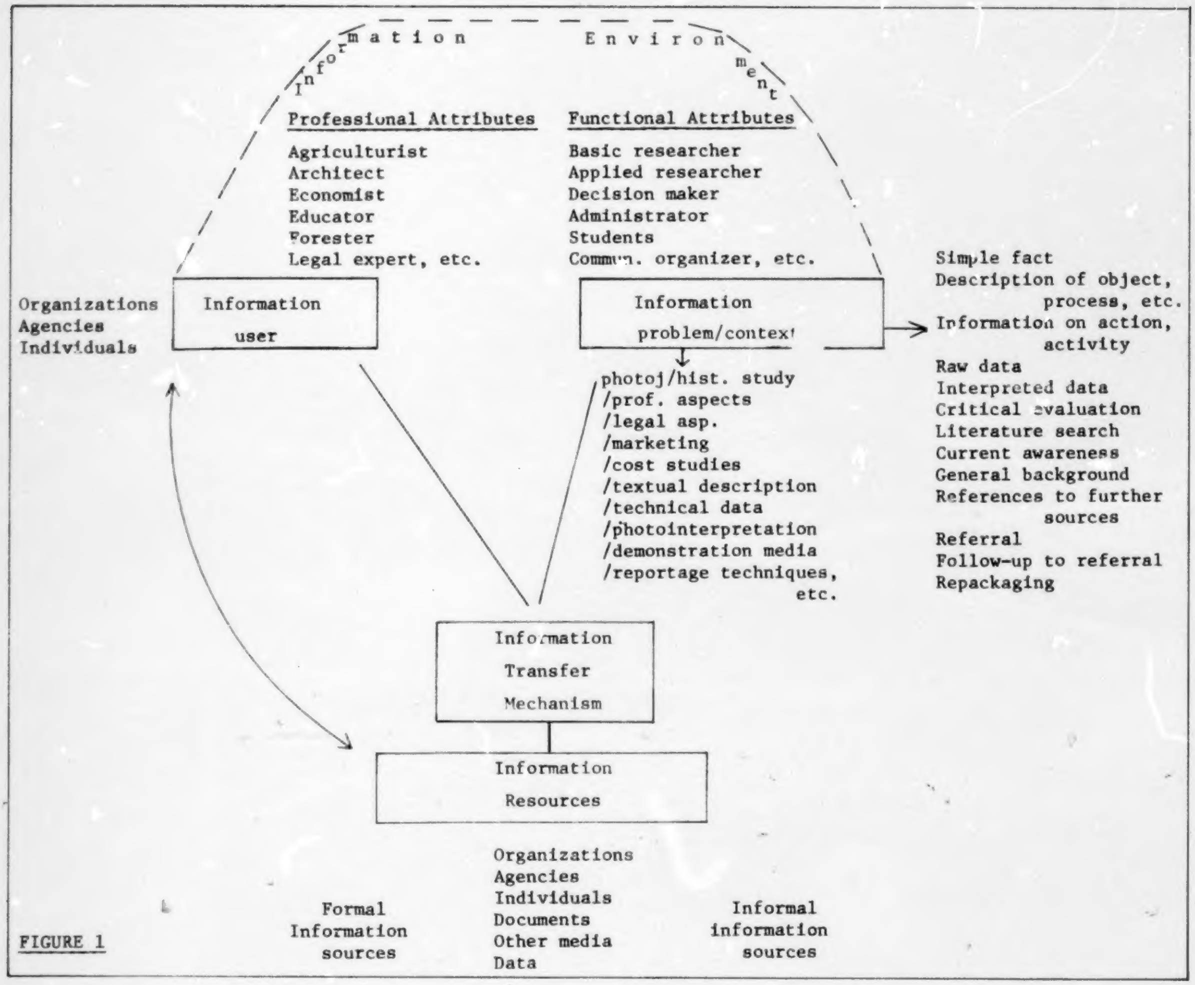
Information Environment
Professional Attributes
Agriculturist
Architect
Economist
Educator
Forester
Legal expert, etc.
Functional Attributes
Basic researcher
Applied researcher
Decision maker
Administrator
Students
Commun. organizer, etc.
Organizations
Agencies
Individuals
Information user
Information problem/context
Simple fact
Description of object, process, etc.
Information on action, activity
Raw data
Interpreted data
Critical evaluation
Literature search
Current awareness
General background
References to further sources
Referral
Follow-up to referral
Repackaging
photoj/hist. study
/prof. aspects
/legal asp.
/marketing
/cost studies
/textual description
/technical data
/photointerpretation
/demonstration media
/reportage techniques, etc.
Information Transfer Mechanism
Information Resources
Organizations
Agencies
Individuals
Documents
Other media
Data
Formal Information sources
Informal information sources

FIGURE 1

Simple fact
Description of object, process, method or event
Information on actions, activities, measures
Raw, uninterpreted data
Condensed, aggregated or otherwise treated data
Descriptive historical summaries
Critical evaluation and review of facts, actions, data
Retrospective literature search
Current awareness browsing material
Material for general background study
References to further sources
Referral to institutions or individual experts
Follow-up to referral
Special types of information repackaging
    Translation: language to language
    Translation: microform to full form
    Translation: from one level of sophistication to another
    Translation: from one professional jargon to another

An approach to the identification of and planning for information needs on the basis of the problem/context - a combination of the information environment, the user's purpose and the scope/type of information - could bypass the need to depend on generalized information user categories when designing systems. We may find that the benefit for the user would be more individualized service. This, however, is a vague hypothesis that cries for rigorous testing.

## II.3. Information Resources

II.3.1. An integrating approach. The third component in our model, comprising the whole range of information resources, is probably the most arcane, stupendous and frustrating one of our present set of topics. The question of how to systematize knowledge in a field that stands at the crossroads of science, and society, and touches upon all human activities has long disturbed information users, producers and disseminators. Traditional schemes of organizing knowledge fail because environmental concepts and their interpretations cut across all disciplines. They are in turmoil and their interrelationship with other concepts are unclear. The fact that most sources, prefer the ambiguous plural, "environmental sciences" to the demanding singular of "environmental science" that would demand a hard-edged definition, indicates that the environmental field is not yet a full-fledged discipline.

Although there are a few relatively new secondary information services that are directed at the interdisciplinary environmental scientist, the information user, is well advised to turn to a multiplicity of discipline-oriented sources in order to cover the literature. To make some strategy possible, the entire field may be divided into two sets of topics: (1) problem areas, (2) disciplines and professions that bring their own concepts, methodologies and attitudes to bear on the problem areas. A partial list will suffice to illustrate this integrating approach:

| Problem areas | Discipline-oriented approaches |
|---|---|
| Air pollution | Agriculture |
| Conservation | Architecture |
| Energy | Economics |
| Food, nutrition | Education |
| Land use | Forestry |
| Marine pollution | Law |
| Noise pollution | Medicine |
| Population control | Planning |
| Thermal pollution | Science |
| Visual pollution | Sociology |
| Waste disposal | Technology |
| Water pollution | |

Two search models may demonstrate the flexibility of manipulation available under this approach. (1) A literature search on the "effects of air pollution on the respiratory tract" may start in a problem-oriented abstracting tool, focusing on the "pollution" aspect, or in a discipline-oriented tool, emphasizing "health" as a subject, or in a specialized source bridging problem area and discipline. Thus, the following secondary services could be searched in any sequence:

*Air Pollution Abstracts* (U. S. Environmental Protection Agency)
*Selected References on Environmental Quality as it Relates to Health* (U.S. National Library of Medicine)
*Abstracts on the Health Effects of Environmental Pollutants* (BioSciences Information Service)

(2) Let the second example be "Chemical aspects of the eutrophication of a lake." Depending on his familiarity with either water quality information or sources for chemists, the searcher may start in *Selected Water Resources Abstracts* (U.S. Environmental Protection Agency), or *Water Quality Abstracts* (Pollution Abstracts, Inc.), proceed into discipline-focused *Chemical Abstracts*, and end the search with the specialized *Eutrophication Abstracts* (U.S. Department of Interior) or vice versa. Special considerations such as an inquiry into research-in-progress or an interest in the effects of water quality planning and development would lead to additional services that form an interface between problem area and discipline, for instance, *Water Resources Research Catalog* (Smithsonian Institution, Science Information Exchange) and *Impact of Water Resources Development* (Environment Information Center, Inc.) This two-dimensional approach has the advantage of flexibility and expansiveness. "Problem areas" and "disciplines" may be added depending on the search objective. Primary, secondary and tertiary publications, professional organizations and their information services may be envisioned in the same scheme.

Superimposed on the problem area/discipline relationship are three broad categories of information resources: (1) Informal exchange of information between individuals through meetings, telephone calls and other contacts of the invisible college, (2) the published and "unpublished" literature that passes through both formal and informal channels and includes such sources as theses, technical memoranda, drawings, in-house publications, etc., (3) data in raw or interpreted form. There is, of course, no one place where a critical evaluation of secondary sources, such as indexing, abstracting, current awareness and other services, providing at least some access to primary resources, would be available. The summary report on the National Environmental Information Symposium (sponsored by the U.S. Environmental Protection Agency) [38], and papers presented at the University of Illinois' Allerton Park Institute in 1972 [39], constitute a "first stop" for the information user who wants to familiarize himself with the environmental information scene in the United States. The first publication is a descriptive review of major issues and problems, the second includes, in addition to insights from a variety of professional viewpoints, a number of valuable references to environmental organizations, information systems and publications.

Rather than repeat some of the bibliographic data available in the Allerton Park Institute's papers, I propose to discuss characteristic *types* of environmental information generated by organizations and individuals.

*II.3.2. Organizations and individuals as information sources*. The role (and even the definition) of non-governmental organizations (NGOs) in international scientific cooperation is a nebulous and controversial matter. Although the significant contribution of NGOs to the success of the United Nations Conference on the Human Environment is beyond doubt, Stockholm was a rather unique convergence of intellectual and emotional forces, and its success has not been repeated since. The influence of scientific, professional and voluntary organizations on international environmental strategies is far from being visible. The problem is, that many international organizations that have official consultative status with the U.N. Economic and Social Council, and thus are allowed formal input into the developmental planning of member countries, have general programs rather than specific expertise in environmental affairs, (e.g., International Council of Scientific Unions, International Council of Voluntary Agencies, International Council of Women, World Federation of UN Associations, etc.) On the other hand, many NGOs, which are exclusively concerned with environment, and may have scientific expertise represented in their membership, have no consultative status with ECOSOC, because they are considered national organizations, even if they have international membership. The question is in the hands of the Committee on Nongovernmental Organizations of ECOSOC. It is rather difficult for the scientific community and for the general public to find uncomplicated information sources about these problems and processes.

However, the collective thrust for citizen participation in public affairs and for NGO participation in international governmental affairs is beginning to produce some results. Governments and the United Nations may not realize yet that the research and education programs of NGOs can significantly contribute to environmental problem solving and awareness, but at least there are signs of the emerging role of NGO expertise. The establishment of the United Nations Environment Programme (UNEP) in December 1972 signaled in a series of meetings of organizations with strong environmental programs. The Union of International Associations called on the United Nations and other intergovernmental bodies to "help build recognition of voluntary and NGO groups as constituting a 'Third World' in organizational terms when related to the governmental and business organization worlds - a Third World which needs to be developed for balanced social change." [40]

What are the implications for the information user? The first thought that comes to mind is that there is a great need for sophistication on the part of information seekers about the relationships between the public and the private sectors, and the role of organizations in environmental action. Knowledge of an organization's mission, partisan commitment, political profile and clout, its involvement in social action, scientific research or professional education, may lead to a more informed and purposeful use of their publications and information services. The second thought that occurs to me is rather discouraging. It is well-nigh impossible for any one individual to keep on top of that kind of intelligence.

For instance, many of us may wonder why some highly industrialized countries, which use indicators of gross national product, cost of living, and unemployment evaluating economic policy, do not have adequate environmental indices for their national environmental policy planning. "Many obstacles lie in the path of developing environmental indices" - wrote Russell E. Train, when he was Chairman of the Council on Environmental Quality - "For some aspects of the environment there are conceptual questions that must be answered. For example, we know that land use is a basic component of environmental quality, but at this point it is not clear what aspects of land use we should be measuring. Good indices depend upon good data, but the environmental data now being collected are deficient in many respects." [41] Yet many scientific organizations, academic institutions and government agencies are developing large bodies of scientific data and knowledge relating to the environment. Only an understanding of relationships between these components of society could enable a scientific organization, academic department or individual scientist to have access to data for his own work, and to contribute to a concerted national effort in environmental planning.

When it comes down to truly crucial information about resources for scientific program funding or program continuation, for instance information about the interests, mandates, capabilities and leanings of funding agencies, new legislation governing the allocation of research funds, administrative regulations affecting various aspects of industrial development, or data necessary for coping with a scientific/societal problem such as energy resources, the most trusted and viable source for most individuals is the invisible college. The "system" outside of all systems will produce results when formal data bases fail. Because of this emphasis within the scientific community on informal channels and human information networks, in Figure 2 I indicate some types of information - produced by institutions and individuals within them which, in turn, may be tapped by information seekers. There is need for further research into the motivations and constraints that influence the generation and communication of such information products.

Even this inadequate list of information products may indicate the fundamental difference between informal and semi-personal information sources and the traditional journal, map or monograph. Formal literature, - even if it is called "unpublished", as technical reports, theses, preprints and reprints are, because they don't go through regular trade publishing channels - lends itself to traditional ways of acquisition by a library or information center. On the other hand, some of the information products identified in Figure 2 can be obtained only by direct contact with the organizations or individuals who had produced them. The trend toward more and more reliance in multidisciplinary fields on direct contact and individual expertise is shown by the increased use of "human resources guides". These may include anything from the familiar "Who's Who", through community program catalogs indicating names of participating experts to various forms of "people's yellow pages." Such guides are of special value if they show the extent an individual is willing to share his/her expertise on an informal, voluntary basis. [42]

Guides to organizations are either formal and comprehensive directories supplemented by some updating service, or small, specialized guides (for instance anti-noise pollution groups in a certain geographical area), or anything in between. The Yearbook of International Organizations [43], World Directory of Environmental Organizations, [44], World Directory of Environmental Research Centers [45], World Directory of Environmental Education Programs [46] address themselves to various audiences and show various emphases. One of the most interesting compilation was issued as a United States Senate document: Survey of Environmental Activities of International Organizations. [47].

Not only agencies, organizations, corporations, unions and educational programs are listed in Environment U.S.A., but also environmental officers of American corporations, union staff members and consultants. [48] The possibility of information referral from a formal system to a resource person at the national or international levels is enhanced by such publications as Who's Who in Ecology, [49] and Who's Who in International Organizations. [50]

Each in a different way, the following sources will keep one up-to-date on international organizations and their publications. Bibliography, Documentation, Terminology [51], published by UNESCO, is an unindexed bulletin listing national reports on bibliographic and network developments in various countries. Reports are coordinated by the International Information System on Research in Documentation (ISORID.) International Bibliography, Information, Documentation is published quarterly in New York, providing descriptive abstracts of FAO, GATT, ILO, UNESCO, WHO, and other specialized agencies in the United Nations family. [52] This is complemented by the United Nations Documents Index, covering the U.N.'s output, exclusive of the specialized agencies. Critical and analytical insights into the operations and style of international governments is offered by the monthly International Associations, published in Brussels. [53] In the interaction of NGOs with the United Nations Environment Programme, this journal serves as the mouthpiece of NGOs, and it is an excellent source for an untarnished view of their international role.

INSTITUTIONAL

INFORMATION PRODUCTS

- Agency history/archives
- Operational policies
- Operational measures
- Strategies, plans
- Cost analyses
- Forecasts
- Internal communications
- In-house staff manuals
- Decisions
- Regulations
- Codes
- Standards, specifications
- Research data
- Indices of environmental quality
- Environmental impact statements
- Developmental plans
- Process descriptions
- Patents
- External communications
- Press releases
- Agreements
- Contracts
- Short-term projects, and programs
- Committees, panels, task-forces
- Conferences, meetings, symposia (Video conferences)
- Training and educational programs
- Information systems

MOTIVES AND CONSTRAINTS

- Economic/political parameters
- Social environment
- Institutional goals, missions, tasks
- Tradition, custom, pre-preference leadership, change agents
- Legal, regulatory restrictions
- Priorities set by sponsorship
- Internal priorities
- External power groups
- Internal power groups
- Agency competition
- Lack of information
- Information overload

INDIVIDUAL

INFORMATION PRODUCTS

- Expertise
- Ideas
- Methods
- Processes
- Compounds
- Engineering designs
- Maps
- Field observations
- Laboratory observations
- Research data
- Collection of samples
- Collection of specimens
- Office files
- Document collection
- Translation
- Statements, opinions
- Letters, memoranda
- Lectures
- Unpublished papers
- Proposals
- Special products
- Informal and oral communications
- Human networks
- Invisible colleges
- Formal publications

MOTIVES AND CONSTRAINTS

- Creativity
- Professional goals
- Disciplinary goals
- Research trends
- Influence by peers
- Status rewards
- Economic incentives
- Project support
- Intergroup relations
- Leadership
- Priorities
- Technical know-how
- Special skills
- Professional tradition
- Change orientation
- Need for individual privacy
- Personal commitments
- Lack of information
- Information overload

FIGURE 2

## II.4. Information Transfer Mechanisms

The function of the information transfer mechanism, whether a complex interactive facility, or a human voice on the telephone, is to connect information users with relevant resources. Because he will seek information through this mechanism, for the user it will represent the complexity or simplicity of the whole system.

This section touches upon three types of information systems: (1) Data banks, (2) information exchange systems, (3) referral systems.

First, the user is referred to two basic conceptual discussions of present and future systems, the UNISIST Study Report on the Feasibility of a World Science Information System [54], and Information for a Changing Society, Some Policy Considerations, by OECD. [55]. From historical background to projection into the future, UNISIST offers a self-disciplined, systematic and incisive review of science information systems, with many examples of national and international efforts. But probably it is OECD's sharply focused, exquisite report that will be remembered as a classic. It is based on the thesis that (national and international) policy for science/technology is necessarily dependent on policy for social goals, and that neither could be separated from policy for information. The most important conclusion, that the user needs individualized, specially packaged information rather than a great quantity of data, very sensitively marks a growing global trend. Information systems are envisioned in conjunction with educational functions: "The information system must bear the burden of responsibility for adaptation and not force this burden on the potential user. At the same time, however, the educational system must prepare potential users to take full advantage of the information resources available to them."

At the present, there is no one source that would comprehensively survey and evaluate existing information systems. The Inventory of Major Information Systems and Services in Science and Technology, issued in 1971 by OECD is already outdated. The Encyclopedia of Information Systems and Services, currently being prepared for its second edition, will include a significant number of international data bases. [56] Since abstracts published on a current basis represent widely used document surrogates, the world-wide machine-readable inventory of abstracting and indexing services, a project of the National Federation of Abstracting and Indexing Services (NFAIS) has far-reaching importance. The final master file is expected to be completed late in 1974.

II.4.1. Data Banks. Information needed to solve pollution and other ecological problems often comes in numerical or quantitatively expressed data and is collected in tabular form. Data on the genetic effects of drugs, industrial chemicals or food additives; the toxicity of pesticides; meteorological or hydrological observations used to be thought of as part of the research apparatus of direct scientific investigation and development, while information expressed in document form came under the purview of documentation, librarianship and information science. None of these arbitrary lines of division and responsibility can hold in the face of increasing need for data applications, growing number of data centers, and problems in data management. In environmental science, for instance, data centers need a convergence of professional talent, and a commitment to cooperation of both scientists and environmental information specialists.

Broadly speaking, information from data banks emanates in two forms, either as untreated, raw data or as aggregated sets of data analyzed, evaluated and arranged to facilitate use. The latter "repackaging" activity has created a special form of data bank, the information analysis center. Information seekers find that there is a great deal of ambiguity and a general lack of simple, straightforward guidance whenever they attempt to (a) locate a data center relevant to their research interest, (b) find out about the legal, institutional and technical constraints that govern access routes to the data, (c) learn about special services, if any, offered by the data center, such as a current awareness mechanism, the publications of evaluated and condensed data in tabular form or a user's manual.

Two concerns come to mind immediately. First, there seems to be a great need for reflective conceptual analysis of problems relating to data centers. What happens in the process that transforms raw data into information? For example, analyses of water samples taken at a sampling station on certain dates produces data elements that may be compared with values established by water quality standards. Results of the comparison may be synthesized, summarized and "packaged" into various professionally acceptable forms for use by water quality engineers, regulatory agencies, planners or economists collecting information for environmental indicators. What sets of data will produce what type of information? Is it possible to plan data services with the "problem/context" of various disciplines and professions in mind? This and similar questions mark another area that needs research attention.

The second concern is, how do potential information seekers become aware of the variety, the existence and the services of data collections? Less than two years ago, a group of systems designers, in the U.S. coming from various academic and professional backgrounds, stated, "...existing earth resource information sources are disparate - they cover many different aspects and appear in many diverse forms. In addition, these sources are widely dispersed.... more importantly there is considerable disorganization of these data and information sources.......instances have been reported where one state's geological unit did not even know that the forestry unit had conducted aerial photographic surveys." [57]

The difficulty is compounded at the international level. The "Recommendations for Action" of the United Nations Conference on the Human Environment contained numerous references to existing and suggested data centers under U.N. sponsorship. To coordinate new activities with on-going research and technical data compilations became the task of the new United Nations Environment Programme. While new projects emerge in both the public and private sectors and international groups under UNEP, UNESCO, ICSU, WHO, OECD and other organizations study the problems of complexity and task alignment, the individual researcher perceives only confusion. Following the establishment of an intergovernmental program, for instance FAO's Soil Data Processing System, UNESCO's International Biological program,WHO's International Reference Centre for Waste Disposal, or OECD's Neutron Data Compilation Centre, there is little internationally diffused, visible information on the program beyond its first announcement. Who will have access to data, in what form, will there be any evaluation and condensation, will there be any affiliated document service? Science journals and bulletins in various disciplines pick up news about the development of interdisciplinary programs haphazardly. Not all information seekers know how to get on the mailing list of programs, for press releases and announcements, but even if they could, they would be inundated by an unnecessary density of information. Conference coverage of international programs is spotty, and with the overall decrease of travel funds fewer people can depend on it than some years ago.

In the United States this situation should be improved by the recent establishment of the Center for International Environment Information by the United Nations Association of the USA in cooperation with UNEP. The center will draw on a network of cooperating institutions in other parts of the world for reports on international environmental developments. Three clienteles in North America will receive this information: business and industry, the media and other large institutions and organizations; specialists in environmental affairs; and the public. The Center offers assistance to UN Associations in other countries which want to set up a similar facility. [58]

Specific information about data centers may be obtained through (a) discipline-oriented guides and descriptions, usually published in the professional literature of that discipline. For instance, FAO's Forest Tree Seed Center would be included in a guide to forestry data source, (b) Organizational guides, covering several disciplines. The above mentioned Forest Tree Seed Center would also be included in a source describing U.N. sponsored programs and data banks. (c) a few sources covering research-in-progress which would lead to data bases accumulated in the course of a specialized project, (d) special compendia and directories including numerical data bases.

In the United States, the Science Information Exchange (SIE) of the Smithsonian Institution analyzes and codifies on-going or planned research for a computerized data bank, and produced Environmental Pollution: A Guide to Current Research. (1971) The National Referral Center for Science and Technology in the Library of Congress maintains a registry of specialized information centers and other potential sources. Because of the multidisciplinary nature of the environmental field, social and behavioral science data are of utmost importance. The new Directory of Data Bases in the Social and Behavioral Sciences covers data files from more than 685 organizations throughout the world. [59] OECD publishes a series called OECD Informatics Studies, with the first report covering Computerized Data Banks in Public Administration.

Internationally the evaluation and compilation of numerical data has been coordinated by the International Council of Scientific Unions' Committee on Data for Science and Technology (CODATA). Its publication, International Compendium of Numerical Data Projects lists tables of constants for the basic sciences, and compendia of data centers around the world, [60] and its Newsletter serves as a current awareness medium. In the United States data evaluation is centered in the federal government's National Standard Reference Data System (NSRDS), which covers the physical sciences. Since 1972 the Journal of Physical and Chemical Reference Data disseminates the critical tabulations of the system. The United Kingdom, and the Soviet Union have similar facilities, and other countries, including Canada are developing them.

II.4.2. Information Exchange Systems. Many contradicting definitions exist in this area. The traditional tasks of an information exchange system are (1) to provide access to information, (2) to supply relevant document(s). Automation of environmental information systems is not necessarily advanced because, as a report of the Economic Commission of Europe expressed it, "the use of up-to-date, sophisticated equipment may require expenditures which, however justified for certain other purposes, may be found prohibitive in the field of the environment where benefits arising from an improved information flow may be difficult to assess on a short-term basis." [61]

Environmental information exchange systems may be divided into at least three categories:

A. Information analysis and dissemination centers. Some of these extract the information from journals, bulletins or indexing and abstracting services, analyze and repackage the information for specialized user groups. Others serve as intermediaries between producers of machine-readable data tapes and consumers. Sponsors of services include governments, industry, academic institutions and private research organizations.

B. Publications services. Examples of products are current awareness, indexing and abstracting, selective dissemination services, critical reviews, custom-made literature searches, state-of-the-art monographs, and compendia, with or without loan of documents.

C. Libraries, information centers, documentation centers, archives. Traditionally these facilities emphasize the collection, organization and on-demand retrieval of information rather than its evaluation, repackaging and dissemination. Since documents form the backbone of these systems, the question of classification schemes is a crucial one for the retrieval of environmental knowledge. Traditional classification schemes are in need of change, and some of them are currently being investigated in the light of new interpretations of "environmental science." [62] In the limits of this paper only information analysis centers and indexing and abstracting services will be mentioned. Libraries, documentation centers, etc., are covered by Bibliography, Documentation, Terminology (UNESCO.)

How does an information seeker learn about the existence, characteristics and availability of services? On what basis can he evaluate them? He can apply a formal approach, for instance statistical analysis, or he can draw up a checklist of some questions concerning the clientele served by the system, priorities in service, nature and scope of the data base, time and cost factors, level of specialization, availability of individualized searches, availability of technical data in summarized and evaluated form, ease of locating source document, form of output, evidence of referral and follow-up services. He should also consider the probability of locating such specialized types of environmental information as environmental impact statements, clean air or water standards, pollution control cost-benefit analyses, government regulations or implementation schedules.

It should be kept in mind that even those large machine-readable data bases that are considered user-oriented and fairly comprehensive, regularly exclude certain categories of information. Some of the excluded areas are highly significant to a crossdisciplinary audience. Most large-scale systems issue users' guidelines, a newsletter or explanatory notes incorporated in their secondary publications. These sources should be checked for the system's criteria for coverage. The following types of documents are often excluded: Administrative procedures, lectures, discussions, descriptions and applications of equipment, legal actions, legislation, newsreports, opinions and preprints.

An uneven, but still fairly useful approach to the selection of environmental bibliographic data bases and secondary services would take the user through some state-of-the-art type of publications. The Advances in Environmental Science and Technology publishes substantial review articles some oriented toward international affairs, with 70-80 bibliographic references each (Wiley-Interscience). The Annual Review of Information Science and Technology (American Society for Information Science) occasionally covers international developments (for instance in v.6, 1971), but references to environmental information systems are scarce. [63] New international information services are often mentioned in the alerting journal Information, published by Science associates/international, Inc.

The coverage of a new crossdisciplinary environmental indexing or abstracting service would be best evaluated in comparison with selected discipline-oriented services. For example, the monthly Environment Abstracts[64]was compared with ten well-known indexing and abstracting publications as to its coverage of journals, subject headings and authors, and showed superiority of specialization in environmental topics. [65] To evaluate one of the field's most ambitious tools, Environmental Periodicals Bibliography, a list of tables of content [66], one would have to compare it with each of the three components of Current Contents. [67]

Examples of international information systems which have potential usefulness for the environmental scientists, include the INTERNATIONAL FOOD INFORMATION SERVICE, Reading, England, the INTERNATIONAL INFORMATION SYSTEM FOR AGRICULTURAL SCIENCES AND TECHNOLOGY, sponsored by FAO, Rome, Italy, INTERNATIONAL NUCLEAR INFORMATION SYSTEM, a section of the International Atomic Energy Agency in Vienna, the INTERNATIONAL ROAD RESEARCH DOCUMENTATION, Crowthorne, England, and others. No single survey of all types of information systems and data bases has been made to this date, but with the current international interest in networking, this will be a natural byproduct of interorganizational cooperation. UNISIST plans to undertake such a survey, although the parameters of their inventory may not include all types of systems.

II.4.3. Referral Systems. Of the various types of information exchange arrangements, the use of referral mechanisms is the most recent one. I will discuss the function of referral in two different settings: (a) the switching of individuals's inquiries to institutional information sources such as an agency or organization, (b) the switching of one individual's inquiry to another.

Referral has been defined as "the indication of sources (persons, institutions, publications, etc.) from which scientific information may be obtained on a given subject; mechanisms for switching users to such sources." [68] Scientific information as an objective has been emphasized because the first formal information centers were created to serve the scientific research community. A somewhat different model has been developed for use by social service delivery agencies, and now is beginning to play an increasing role in the information flow of communities.

The UNISIST program proposes to systematically inventory science information resources and systems, to enter them in a World Register, and develop a global information sharing program. At the heart of the entire design, referral is envisioned as the only really feasible form of sharing human, institutional and media resources.

Since UNISIST is a remarkable effort to "synthesize a diversity of philosophies, programmes and policies that relate to the free flow of scientific and technical information," environmental information users would find that UNISIST developments are highly relevant to their interests. For instance in a development that signifies international cooperation, the Canadian government has offered to make available, through UNISIST, the model, expertise and software package of the Canadian selective dissemination of science information program (CAN/SDI) to UNESCO member states.

One of the youngest intergovernmental organizations, the United Nations Environment Programme (UNEP) has been mandated to develop and serve the unified concept of the human environment, as formulated at Stockholm. The role of UNEP's "Earthwatch", a global monitoring and environmental assessment program has been well publicized in the scientific world. Less understood is a vital component of "Earthwatch", the International Referral System (IRS). Currently in its pilot phase, the system is undergoing a period of conceptual evolution. It was originally conceived as a service available to the United Nations and member states only, but the non-governmental community hopes that it will be extended to broad strata of user populations. Designers of the pilot phase recommended that the network include partners who can be anything from a large-scale data base to a single individual. They envision a system of national focal points where referrals will be switched to national subsystems. There will be also "sectoral," or subject-oriented centers, each depending on its own partners. The IRS intends to use existing facilities, and depend on a directory of world-wide cooperative information facilities. The directory will be made available to all national and subject-oriented centers in the network in either full size, microfiche, ultrafiche or computer tape form. In addition to subject-keywords, other characteristics may be used to identify the best potential target for referral, for instance the potential information source's sponsor, objective, function, type and availability of information. [69]

Currently IRS headquarters are still in Geneva, while the UNEP Secretariat moved to Nairobi. A decision authorizing the actual operation of the IRS system will be made in March 1974, at the second meeting of UNEP's Governing Council.

### II.5. Information Exchange Outside of Formal Systems

Two strong themes run throughout the entire environmental information problem, (a) increasing people-orientation in both information seeking and delivery, (b) use of innovative approaches, especially referral to resource people. These themes manifest themselves in both the international and local dimensions of information service.

The International Referral System is building a pattern of interaction with experts in various fields into its program from the outset. "In the field of the environment there are often no definite answers to questions, and those that exist are seldom transferable from one situation to another. Experts will have to be consulted in connection with the analysis and compilation of answers and even, in many cases obtained." [70]

In an entirely different, local setting, a newspaper publisher asked "Suppose a newspaper confronts an environmental problem of some complexity.....What avenues exist for independent review of the project?.... What if the university.....was able to prove to be an instant resource? Experts from its own ranks, from other universities, from newspapers, from the classroom, from wherever could be available for telephone discussion of the parameters of the problem. If an on-site inspection seemed warranted, the task force could assemble at the behest of the newspaper to examine the issue at first-hand and present a report through the newspaper to the public." [71]

So the pattern of individuals envisioned as resources is carried all the way to the community level. What does this mean in terms of environmental information? There are those who insist that conflicts concerning economic development and the quality of life will be handled at top decision making levels, without ever filtering to the grass-roots except in the form of tokenism. And there are those who believe that environmental issues will be decided at the community level, with strong citizen participation. One thing is certain: chances for the latter prospect would be greatly enhanced if citizen groups and community organizations would have a more reliable and credible information base. This information base must not be delimited by the parameters of formal information systems or even the anonymous expertise of cooperating institutions. For a community referral service, the difference between a list of agencies with names of key communicators or without them could be the difference between a successful referral and hours wasted in the bureaucratic maze of agency telephone channels.

Now, if networking, including resource people is a continuing trend, what are those issues we must face in order to make this approach work? Basically five sets of problems confront the information community:

1) The information seeker, whose complex and elusive information needs could be understood only through awareness of new psychological styles and societal interrelationships.

2) The information professional, who in many cases is not prepared to deal with either the behavioral aspects or the multidisciplinary nature of environmental information service.

3) Primary and secondary information sources which are traditionally organized by (a) type of agency, library or media center, (b) discipline and/or subject, (c) form of information. Thus much of the available documentation is organized into collections and systems that have little relevance to environmental information.

4) The location of information. There exist large quantities of data and documents which are

"hidden" and invisible to the user. They are continuously being accumulated by agencies, organizations, short-term programs and projects, neighborhood and advocacy groups, etc. In many cases it is not the unwillingness of the information holder but the lack of referral mechanism that forecloses the use of these sources.

5) Human resources. In many communities there is a lack of awareness of groups and individuals who have specialized knowledge and who would be willing to share it on either a voluntary or a consultantship basis.

An awareness of this situation in recent years has resulted in the exploration of relatively new methods in information transfer outside of formal systems, information centers or libraries. Two of the new approaches are (1) Information counseling and referral, (2) information repackaging. Some aspects of these activities have been mentioned throughout this paper, therefore, this section intends to give only brief definitions.

The objective of information counseling and referral are to bring various resources, both inside and outside of formal systems, to bear on information needs. Conseling, for which models have been developed in social casework, utilizes the interview process, combining an assessment and diagnosis of the individual's or agency's needs with an evaluation of alternative resources. [72] In social service "information and referral centers" have been used for many years. Their main functions are to develop and manage resource files, give direct service to clients and participate in the planning of new services. [73] In information science, the conceptualization of a "referral center" is undergoing a traumatic period. The great variety of prototypes include the Citizens' Advice Bureaus developed in Britain during World War II, and the planned International Referral System of UNEP. Follow-up is seen as a vital aspect of counseling and referral.

Information repackaging, though not a new concept to the publishing industry or large-scale data banks, is still relatively untried in traditional information services. The repackaging or "translation" of scientific and technical information into forms appropriate to the needs of administrators, policy makers, legislators, urban and regional planners, educators and the layman, has received considerable attention by various sectors in society. The OECD report, Information for a changing society stated, "The effectiveness of human activities can only be assessed on the basis of a complete chain of events ... Exchange of knowledge is needed within each group...it may need translating into another "language" for transfer to other groups in other tasks." [74] In the United States, such environmentally oriented organizations as the Scientists' Institute for Public Information, the Center for Science in the Public Interest, and the Union of Concerned Scientists already consider their interpretation of environmental science facts for the public, a vital role.

On a final note, what does all this mean for the future? Even in this very sketchy landscape of the environmental information field we have a glimpse of the magnitude of changeability, complexity, and fragmentation. The field is not only multidisciplinary, but also multi-jurisdictional and multi-institutional. Although there are few information services designed for environmental science, almost every existing service has data with potential environmental application, services operated by regional, national, state and municipal agencies, public and private research institutes, monitoring stations, statistical offices, legislative bodies, courts, educational institutions, health and social service facilities. Around the world, in innumerable committees, task forces and ad-hoc professional groups the social scientist is called upon to discuss the interrelationship of atmospheric, hydrospheric, lithospheric and biospheric data. The physical scientist is asked to appreciate the growing importance of data for mapping social trends. Collectively they are expected to immediately translate and interpret their findings for the layman.

There are indications that, increasingly, the management of the environment will be based on measurements and indicators rather than on romanticized assumptions. However, even if the emotional tenor of the movement quiets down, ideological and attitudinal factors will continue to influence developmental, social and legal measures. Where environmental medicine and economics are concerned, people's fundamental needs are affected: life and survival in a hostile world. Because of its underlying stark reality, environmental information will become more and more personal for each individual. This fact- and data-oriented, yet deeply individualistic and personal approach to knowledge that is both scientific and philosophical, will place an enormous responsibility on everybody: those who generate, use and transfer information. There must be free communication, cooperation and a mutual appreciation of personal views, perceptions and needs. Otherwise we may see information become even more fragmented and environmental decisions around the world made on the basis of information that is irrelevant to human life.

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